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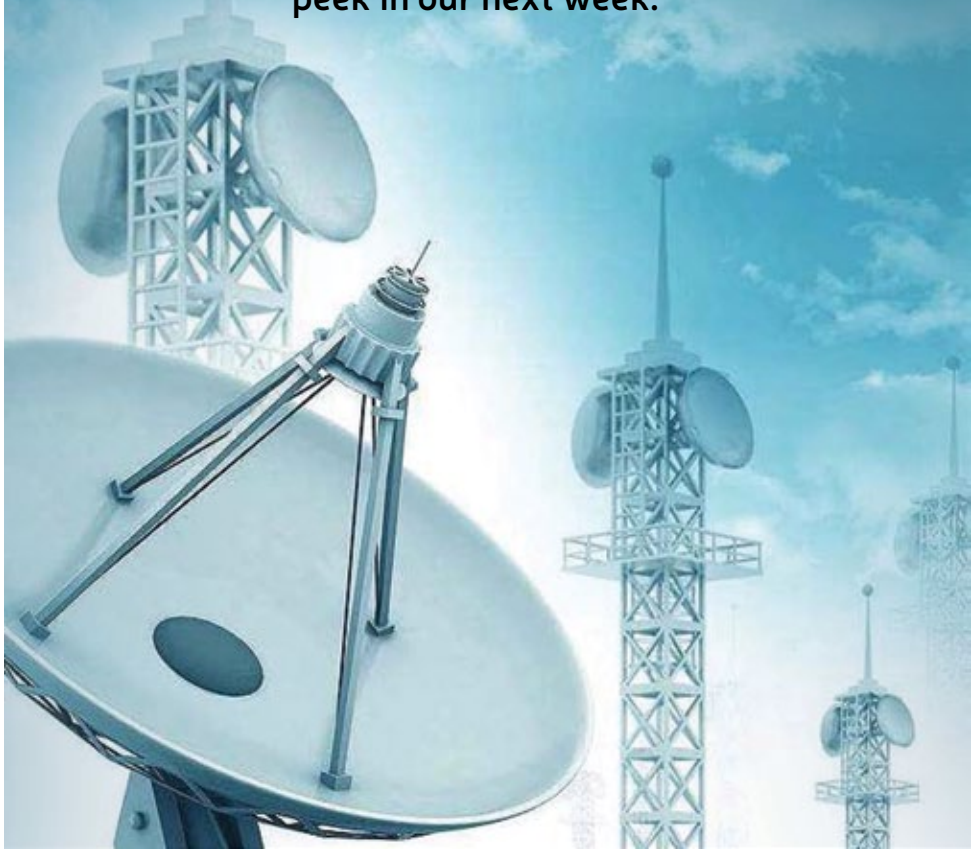
Where are we in our quest for Local manufacturing of Communications networks and Infrastructure – from indigenous Platforms and technology standards to the Internet of Things (IOT), we take a sneak peek in our next week.



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GAJENDRA
UPADHYAY

[OPENING NOTE]

Digital Transformation of Indian Cities

This is a Special Issue in many senses. We have dived deep into and highlighted the huge transformations happening on account of large-scale deployments of technology driven by the Smart Cities Mission (SCM) of 2015.

These digital transformations will create immense value for citizens, quality of life and livelihoods in our country. At current rates of growth, the urban population of our country is projected to reach 60 crore (600 million) by 2030. Nearly 4000 towns and cities will benefit from the unexpected outcomes of the SCM.

Unexpected outcomes in the world of technology are not uncommon. A scene in the James Bond movie Casino Royale back in 2008 showed Bond driving his car and tracking it on a map on his smart phone. A couple of young entrepreneurs watching this scene ultimately converted it into a product that transformed how the world uses a taxi. This is the Uber story.

One unexpected outcome of the SCM initiative was witnessed in the handling of the Pandemic in India.The Integrated Command & Control Center (ICCC) - a core concept embedded in theSCM infrastructure — proved its worthby saving lives. There can be no greater test. Initially aimed at providing a central monitoring station for water and power supplies, building management and traffic situations, it metamorphosed into a new tool - helping in surveillance and management of crowds, contact tracing and quarantine planning. Many cities, like Bengaluru, used the ICCC (with an added layer of Artificial Intelligence, AI) to track availability of hospital beds. Even the KumbhMela in 2019 benefitted — using the ICCC at Prayagraj for handling crowds safely.Nearly 75 cities have already established ICCCs and others are in the process.

In his detailed interview with Voice & Data, the Mission Director of Smart cities, Rahul Kapoor says: “These ICCCs are playing an important role.”From traffic to solid waste management, water distribution and disaster management, ICCCs are being used to improve decision making at (local and other levels of) government.

A second outcome of the SCM that has the potential for huge impact is the Indian Urban Data Exchange (IUDX). Being set up by Dr Inder Gopal jointly under the IISC Bangalore, IUDX is anopen sourceplatform. Its open standard APIs facilitate secure, authenticated and managed sharing of data between silos of information across diverse locations. This platformwill unlock huge value and open up many opportunities for cities to create citizen-friendly initiatives, applications and use cases.

A third transformational outcome is the adoption of Open Standards in machine to machine (m2m) and Internet of Things (IOT) platforms – primarily driven by the Centre for Development of Telematics (C-DoT). IOT is a core technology that is slowly creeping into every aspect of our lives, from sensors in refrigerators and light bulbs, to tracking of garbage trucks.

Together, these technology initiatives and new infrastructure will metamorphoseurban life.There can be no doubt the SCM, six years down the road, has started a slow digital revolution.

gajendrau@cybermedia.co.in

SMART CITIES

SIX YEARS AND COUNTING

The Smart City Mission was conceptualized with a vision to develop 100 lighthouse cities with ICT enablement of projects and service delivery models

BY NSN MURTY & ABHIJIT PANDEY

The world is witnessing rapid urbanization and India is not untouched by this phenomenon. As per world bank's analysis by 2050, the population living in cities could swell to about 66%, adding more than 2.5 billion people to the urban population. Whereas for India, at current rate of growth, urban population will reach around 60 crore by 2030. It is estimated that about 50 percent of the country's population (around 80 crore) will be urban by 2050 (World Urban Prospects, 2018). Rapid urbanization thereby is putting tremendous pressure on population centers and presents a challenge for cities to provide sustainable livelihood to their citizen. To enhance the livelihood, most thriving cities seek sustainable, resilient and safer growth.

Keeping this in mind and to make the cities more resilient, inclusive, and sustainable, the Hon. Prime Minister of India launched an ambitious Smart City Mission (SCM) for the development of 100 cities across India. It is for the first time that a Mission was launched where the projects for the development of the city and the key success factors were decided by "Jan Bhagidari" and where the allocation of funds was to be decided on the basis of competition.

Infrastructure Development

The Smart City Mission was conceptualized with a vision to develop 100 lighthouse cities where key Infrastructure development along with ICT enablement of the projects and service delivery will be implemented. The projects

> Rapid urbanization is putting a tremendous pressure on population centers and presents a challenge for cities in our country. At the current rate of growth the urban population will reach around 60 crore by 2030 and 80 crore by 2050

The 100 Cities Selected Under the Smart Cities Mission

Source: Maps of India.[3]

Rumi Aijaz, "India's Smart Cities Mission, 2015-2021: A Stocktaking," ORF Special Report No. 155, August 2021, Observer Research Foundation.

The 100 Smart Cities have envisioned to implement almost 5151 projects with a proposed investment of INR 2,05,018 Crore.

were identified with three pillars as their core: Quality of life, Economic Ability and Sustainability.

The key performance indicators (KPI) were framed to evaluate impact of these projects on the livelihood of the citizens and the Liveability Index of these cities were identified.

The Smart Cities mission right from its inception has brought ground shifting impact on the livelihood of a few cities. It changed the way projects are conceptualized, brought in digital methods of tendering thereby rooting out corruption and bringing in transparency. The central and respective state ministries have also kept a vigilant eye on the project time periods, thereby expediting the implementation cycle.

As per the Smart Cities data available with the Ministry of Housing and Urban Affairs, across the length and breadth of India, the 100 Smart Cities have envisioned to implement almost 5151 projects with a proposed investment of INR 2,05,018 Crore.

As of January 2022, almost 92% of approved mission projects are tendered, and around 70 percent had either been completed or were under advanced stages of implementation. The projects envisaged by various smart cities not only ranged from various sectors but also catered to the basic requirement of citizens.

The projects comprised of ICT driven Pan City interventions such as digitization of delivery of basic municipal services through e-governance, setting up of Integrated Command and Control Center (ICCC), Supervisory Control & Data Acquisition (SCADA) enablement of Water Management System, ICT enabled Solid Waste Management System, and many more.

These ICT enabled projects have made the service delivery efficient and sustainable. The digitization of service delivery enabled to government to cater to the last citizen in the queue without the middleman, the ICT enabled SWM project brought revolutionary results in the cleanliness drive. The Integrated Command and Control Centre became the brain, arm and legs for the cities during COVID pandemic and the CCTV surveillance provided a sense of safety and security to the citizens

The Mission also comprised of infrastructure related projects which focused on development of a pre-defined area through infrastructure-based projects such as development of central business district, Incubation centers, Vending Zones, Multi-Modal Hubs, etc. These projects utilized the concept of mixed land use and implemented through a public private partnership (PPP) model. They have a strong focus on the economic returns thereby uplifting the liveability of residents of a city.

A few examples of ICT led interventions which have brought significant change in the way services are delivered are as follows:

- New Town Kolkata Development Authority (NKDA) has successfully introduced blockchain technology for its online birth registration process since December 2018. The city has also implemented a one of its kind LoraWan based Smart Energy Efficient streetlights which enabled the city to save approximately INR 65 Lakhs. The city also implemented an App based Public Bicycle Sharing (PBS) System for citizens -- thereby encouraging green growth and non-motorized zones.

- Solid Waste Management project in the Varanasi Smart City (VSCL) utilizes the India Urban Data Platform exchange. VSCL utilized the data collected through various sensors, GPS based automatic vehicle location system (AVLS) devices and provided various priority areas as well as solutions to mitigate SWM related issues in the city. The data assisted VSCL to come up with an app to predict accurately the estimate of dry and wet waste thereby assisting the authority in better planning and resource utilization.

On the infrastructure front a few of the interventions need to be highlighted.

Like restoration and rejuvenation of lakes in the city of Coimbatore. The project consists of clean water, open areas, parks, food stalls etc. Whereas cities like Warangal and New Town Kolkata have created cycling and walking facility for 40 kms as well as graded barrier-free three km cycle track respectively.

The cities identified in the mission are moving towards data driven governance. So far 75 cities have

> The cities identified in the mission are moving towards data driven governance. So far 75 cities have established command and control centers integrating other components such as Traffic, Surveillance, Street Lights, E-Governance modules, SWM, SCADA, etc. The ministry is also thinking of moving toward utilizing existing infrastructures as a service for other cities within and beyond Smart City.

established command and control centers integrating other components such as Traffic, Surveillance, Street Lights, E-Governance modules, SWM, SCADA, etc. The ministry is also thinking of moving toward utilizing existing infrastructures as a service for other cities within and beyond Smart City.

A good example of this is Bhopal Smart City. Here the ICCC platform is on a cloud and the ICCC platform is shared as a service with other 6 smart cities in the state of Madhya Pradesh. This brings down the overall upfront capex expenditure from the cities as they don't have to spend on ICCC platform, the cloud services, the security components, etc.

Though, the Smart City Mission in the last 6 years has been instrumental in managing a rapid urbanization and has impacted the livelihoods of millions of citizens, it will not be wrong to say that the last 6 years of the Smart City Mission have also been a huge learning curve and this learning can be leveraged and utilized to make the program even more effective and outcome oriented.

Next Phase

The next phase of the mission is likely to start focusing on:

i) bottom to top approach for the Smart City projects where the end-to-end mapping of the projects right

IoT Based Monitoring / Tracking system of Based Management

Image CopyRight: Convexicon

> Solid Waste Management project by Varanasi Smart City (VSCL) utilized the India Urban Data Platform exchange. VSCL is using data collected through various sensors like GPS based automatic vehicle location system (AVLS) devices and provides various priority areas as well as solutions to mitigate the SWM issues in the city.

from the GIS mapping to integration with command-and-control center is considered so that proper analytics is run to get a tangible output

ii) the outcome-based approach and the evaluations being done on the tangible output coming from the projects and the initiatives. Currently we citizen's don't have a view of the impact that will be created through a project. A paradigm shift is required in the approach of the project implementation and evaluation

iii) Within a state, multiple cities are doing same project differently, some places they fail, some places they succeed. There is a need for data-driven management and monitoring of both the projects and the funds utilization at the State level for higher efficiencies and more transparency. This State level City-Data Center will also help other important programs like AMRUT, Namami Gange, Jal Shakti, PMAY etc. to be integrated together for seamless implementation at the city level. City-Data Driven approach will make decision makers to get a holistic view of the whole state and help them in making pro-active decisions.

iv) The next important step beyond creating digital & future proof physical infrastructure is to understand the changes that Citizens & Businesses would like to see in the city in the next 5/10/30 years accordingly cities need to get ready with changes in their processes. E.g. will anyone will or need to come to city municipal office for any citizen service in 5 years? How will I utilize the concept of "Digital Rupee" in my processes? Why can't the entire city data (non-personal) in the open domain to enable businesses and startups to use them for economic growth in the city? Why should City Administration run city apps, can I get a private sector under an "Operate" model?

Sustainability

One of the pillars of the Smart Cities is sustainability. Though the focus is to make livelihood sustainable, it is important for the projects being implemented to be financially sustainable. Thus, the approach should slowly be more on self-sustainability of projects.

Towards this, the mission has to come up with an accountability framework for timely completion of projects and better utilization of central/state funds. Secondly, city SPVs need to think on collaboration to create hub-spoke models, not every city needs to implement everything, it can "share". E.g. can I have a single operation for municipal property tax services as a shared and operate model for multiple cities. Therefore, saving a lot of opex and using it somewhere else efficiently. Clubbing few projects also help in creating extra funds for operations e.g. Streetlights with road-side street furniture or City Fiber project with City WiFi.

Finally, another important aspect is focus on social impact projects around healthcare and education, since these are usually delivered by para-statal bodies hence they are not included but without a transformation of these at the city level, we cannot have a smart city. In my view, we should carve out special thematic versions with funding from Ministry of Education and Ministry of Health & Family Welfare integrated with Smart Cities Mission focused on creating world class learning environment and health environment at the city level.

In conclusion. the Smart City Mission, one of the world's largest urban rejuvenation programs, has been a lighthouse for cities not only in India but across the globe, 6 years is just a seeding stage we must ensure that these projects are well managed so that they deliver the desired outcomes in coming years.

We will track this progress further in the months and years ahead.

NSN Murty, Partner & Leader, Government & Public Services, Deloitte Consulting

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Rahul Kapoor
Director, Smart Cities Mission,
Ministry of Housing and Urban Affairs

"Smart cities are preparing us for the challenges of tomorrow"

Rahul Kapoor is currently the Director Smart Cities Mission in the Ministry of Housing and Urban Affairs*. An officer of the Indian Railway Accounts Service he has been responsible for the operational issues related to implementation of Smart Cities Mission projects. He has been involved in program design of various initiatives of the Ministry related to innovation, capacity building, standardization, liveability, and governance of Smart Cities.*

In the Ministry of Railways, as director of Finance, he gained tremendous expertise in design and implementation of Public Private Partnership (PPP) projects which is a foundation for the Smart Cities Mission. Rahul Kapoor has also worked extensively in Rail Land Development Authority on financial appraisal, modelling and management of land development projects.

In a freewheeling conversation with ***Gajendra Upadhyay*** *he outlines the key success factors of the SCM so far and learnings that will be a foundation for the next generation of smart cities in India.*

The context in which the mission was started — improved governance, efficient delivery of services, better use of technology — how far do you think we have achieved these objectives.

Smart Cities Mission is a pursuit of Govt. of India to address larger, vernacular urban priorities of cities, to better the lives of citizens in Urban India.

Total Investments in around 5151 projects worth ₹2 lakh crore (USD 28 billion) in 100 cities is under implementation as part of the Smart Cities Mission.

- **Physical progress:** As on 7 February 2022, 6782 projects worth ₹1,89,312 crore (92% of total projects) have been tendered out of which 6,200 projects worth ₹1,64,593 crore (80% of total projects) have been work ordered. 3463 projects worth Rs. 58,841 crore (29% of total projects) have been completed.

- **Financial progress:** Since the launch of the Mission, the Central Government has released Rs. 28,289 crore for the 100 Smart Cities out of which the Smart Cities have already utilized Rs. 23,998 crore. It is noteworthy that the Utilization of GOI funds in the mission has increased from 18% in Mar 2018 to 88% of total release in Mar 2021.

- **Key projects:** In order to enhance walkability, increase use of non-motorized and public transport, Smart Cities are implementing 776 Smart Road projects worth ₹26,205 crore. Further for driving shift towards renewable sources of energy, these cities are implementing 94 Smart Solar projects worth ₹1,266 crore. Efficient management of water resources is key to climate change mitigation. Smart Cities are implementing 311 Smart Water projects worth ₹23,669 crore.

- In order to better manage used water, these Cities are implementing 262 Smart Wastewater projects worth ₹17,706 crore. 664 projects of bioenergy, conservation of water bodies, mobility including e-mobility, parks and river front development etc. worth ₹11,404 crore are also being implemented by different Smart Cities.

- Despite the difficult times of COVID, the implementation of SCM projects is in full swing. 10 cities have been able to receive full GOI grants under the mission and are also doing some remarkable works. Bhopal, Indore, Visakhapatnam, Ranchi, Udaipur, Kakinada, Coimbatore, Surat, Chennai, Amaravati. There are another 20 cities who have received ₹400 crores each out of our ₹500 crore/city.

What have been some of the surprise learnings from the pandemic that can now become an integral part of technology based solutions for all smart cities.

In my understanding one of the key virtues of a smart city is its ability to be prepared for the challenges of tomorrow. And without any doubt, technology/ digital interventions are going to help us in our preparedness.

The urban sector in India is in urgent need of whole-of-system innovation. In order to address the need for scale and speed, it is therefore essential to use transformational force of data and emerging technologies in all aspects of the urban sectors.

Urban managers and administrators today require innovative tools that can provide them with objective insights on routine civic activities and use advanced predictive capabilities to plan for future challenges. This can ensure that cities have a responsible and sustainable evolution, mirroring the aspirations of their citizens.

The current landscape of technology and its deeper integration with the city dwellers everyday life and activities provides a host of options that can fundamentally alter the way urban challenges are solved.

75 cities have already developed and operationalised Integrated Command and Control Centers (ICCCs) in their cities. The cities have learnt from one-another and the Ministry facilitated this learning.

These ICCCs are playing important role in ensuring better monitoring and efficiency in areas like traffic management, solid waste management, water distribution management. Some of the ways ICCCs impact citizens' lives are:

- Improved decision making for (local and other levels of) governments
- Improved environmental sustainability and climate change outcomes.
- Improved quality of services to citizens
- Safety of citizens
- Making cities more inclusive

But, the biggest contribution of ICCC surfaced during COVID or in Disaster Management, wherein they became the war rooms for decision making. Cities like Bengaluru, Vadodara, Thane, Vishakhapatnam, Bhubaneshwar and Kakinada have deployed Disaster Management, Emergency Response and Early Warning Systems to monitor water-logging, present and manage urban flooding and coordinate disaster management activities.

Some efforts of Smart Cities during the current 2nd wave of COVID, are as below:

- ICCCs leveraged to monitor oxygen supply; increase bed capacity; video conferences with RWA (Ex – Udaipur, Faridabad, Hubballi-Dharwad, Chennai, Belagavi)

- Technology used for accelerated Vaccination drives with community/NGO participation. Engaged with private hospitals for logistics management for patients (Ex – Mangaluru, Raipur, Bhopal)

- Created mobile application/dashboard, for locating the bed availability in city hospitals, drug distribution, with real-time COVID information, helplines etc. (Ex – Nagpur, Tumakuru, Bangalore, Surat, Jabalpur)

- Home Isolation apps for patients, to interact with doctors. (Ex – Chennai, Raipur, Ahmedabad)

- COVID screening tests and vaccination for on-site construction workers and arranging their treatment (Ex –Madurai, Tirunelveli)

Do share any example that strikes you as particularly outstanding in the above.

Smart Cities Mission has already invested in ICCCs as the infrastructure backbone and decision support system for cities, which are using AI to drive urban transformation.

> As on 7 February 2022, 6782 projects worth ₹1,89,312 crore (92% of total projects) have been tendered out of which 6,200 projects worth ₹1,64,593 crore (80% of total projects) have been work ordered. 3463 projects worth ₹58,841 crore (29% of total projects) have been completed.

Though there are many examples, two which come to mind are:

- **BBMP ICCC war room:** In light of Covid, Bengaluru city has established a Covid War Room as a Strategic War Room utilising data for planning, coordination, and monitoring of the crisis. The city is also exploring the use of an AI-based algorithm to predict availability of hospital beds in the city and hotspot management.

- **Kumbh Mela case:** In 2019, "Kumbh Mela Experiment" was set up in the city of Prayagraj to predict crowd behaviour and the possibility of a stampede, using AI for the first time. The Kumbh Mela is the biggest religious gathering in the world and for it, over 1,000 CCTV cameras were used to monitor movements from the event's location spread across 32 sq. kms.

The SPV model was a mechanism to expedite the procurements and implementations. What is your assessments of the Smart Procure model and how has it worked out so far

The SPV model in Smart Cities Mission was a part of its guidelines since its inception on 25 June 2015. It can be termed successful, as 6782 projects worth Rs. 1,89,312 crore (92% of total projects) have been tendered out of which 6,200 projects worth Rs. 1,64,593 crore (80% of total projects) have been work ordered. 3463 projects worth Rs. 58,841 crore (29% of total projects) have been completed.

What is the Open Data Model and how does it fit into the Smart City implementation

Smart Cities can be more effective, when they are led by data-driven governance. The significance of data as the 'Digital Capital' is well established to create new avenues and enhance existing services for citizens through the 'access or sharing economy'.

Towards enabling and operationalizing the above digital ecosystem in cities, the Smart Cities Mission has deployed number of measures at the People, Process and Platform level. Working towards making our cities smarter, we have undertaken several programs and initiatives such as the DataSmart Cities Strategy and the National Urban Digital Mission that was launched last year to help cities unlock the potential of data.

We have also been investing in developing our platforms such as the Smart Cities Open Data Portal and India Urban Data Exchange (IUDX) to propagate the use of data by cities. A dedicated and separate Open Government Data (OGD) Instance has been created by NIC for Smart Cities Mission and https://smartcities.data.gov.in portal was launched during the Second Apex Conference for Smart City CEOs.

The portal is designed to host open datasets of 100 Smart Cities of India and more than 2,600 datasets from 95 Smart Cities is already uploaded on the portal for free access to public. This initiative is in line with the Open Government Data (OGD) Platform India (http://data.gov.in) developed by NIC as per the mandate given in the NDSAP Policy wherein Government departments are publishing their shareable datasets in open format through this platform.

The Mission has further developed the National Urban Innovation Stack to unlock urban India's innovation and growth potential.

We have been designing and developing an 'City Innovation Exchange and SmartProcure' platform to enable open innovation and solution driving in cities and gear the ecosystem for the entry of AI and other emerging technologies. There is an innovative model of procurement for Startups and Innovators through the SmartProcure guidelines issued by the Ministry.

Further, Smart Cities Mission is closely working with MeitY, NITI Aayog and World Economic Forum on an operational strategy to deploy AI and other emerging technologies in Indian Smart Cities. These all initiatives are integral to the aspirations of Smart city augmentation.

What are your views about how the National Digital Urban Mission (NUDM) fits into the government's overall AI roadmap — and how does this leverage deployment of data for greater good.

With data as the capital, AI will become the new factor of production, can augment labour productivity and innovation while driving growth in at least three different ways:

- Mobilise intelligent automation;
- Empower existing workforces;
- Drive innovation.

With Impacts on these three areas AI is expected to raise India's annual growth rate by 1.3 percentage points in 2035. This amounts to an addition of US$957billion, or 15% of current Gross Value Added. National Urban Digital Mission aspires in this direction, and trust me this aspiration has been catapulted in these challenging times of COVID.

As a mission, we are focussing on documenting an AI Implementation roadmap for Cities that can act as a playbook with iterative steps on deployment of AI technologies in various sectors.

You have witnessed the implementations of different cities, among them the softer aspects like Access Friendly cities for the differently abled and for Children. Do share some of your experiences on what is happening in this space

Apart from a huge variety of projects being implemented under Smart Cities Mission towards this, I wish to mention some relevant national challenges being run by Smart Cities Mission in this direction.

Nurturing Neighbourhoods Challenge - The Challenge was launched in the first week of November 2020. It is a 3-year initiative hosted by the Smart Cities Mission, MoHUA in collaboration with the Bernard van Leer Foundation and WRI India. The Challenge enables Indian cities to adopt an early childhood lens in designing neighbourhood-level improvements that promote the health and well-being of young children and their caregivers. Through the Challenge, selected cities will receive technical assistance and capacity-building to improve public spaces, mobility, neighbourhood planning, early childhood services and data management. It is open for all Smart Cities, Capitals of States and UTs, and other cities with a population greater than 5 lakhs. A cohort of 25 cities was selected for further capacity building to implement actions under the Challenge. From these, 10 winners will be identified from evaluations taking place in October-November 2021.

India Cycles for Change (IC4C) Challenge - The India Cycles4Change Challenge launched in June 2020 is an initiative to inspire and support the cities to implement cycling friendly initiative, to encourage cities to experiment cycling and build confidence for a city-level scale-up with the goal to learn, rather than plan to perfection. The challenge will prepare cities to implement cycling friendly initiatives in response to the challenges that the COVID-19 pandemic has thrown. The challenge was open to all cities with over 5 lakh population, capital cities and all smart cities. A total of 107 cities registered for the challenge. Participating cities undertook pilot projects, citizen surveys and training in capacity building workshops. The Challenge is conducted in two phases. The first phase, under which cities successfully implemented a pilot project, received proposals from 41 cities in January 2021. 25 cities were shortlisted out of which 11 were announced winners in July 2021. The second phase of the Challenge requires the 25 pioneer cities to scale up the pilot initiatives based on learnings from the first phase of the Challenge. The India Cycles4Change Challenge aims to create extensive cycling-networks through low-cost interventions like pop-up cycle lanes and traffic-calmed or non-motorized zones.

Streets for People Challenge - The Streets for People Challenge, launched in September 2020, is an initiative to inspire cities to create walking-friendly streets through quick measures, in response to COVID-19. The Challenge will support cities across the country to develop a unified vision of streets for people in consultation with stakeholders and citizens. The Challenge requires each city to test at least one flagship walking project and enhance liveability in one neighbourhood. Streets and public spaces around transit hubs, heritage zones, commercial streets, market areas, recreational corridors or any high footfall zones can be considered as potential locations for the flagship project. For cities under the Smart Cities Mission, the interventions will be a pan-city initiative and not limited to the ABD area only. The Streets for People Challenge is open to all cities under the Smart Cities Mission, capital cities of States/UT's and cities with a population of over 5 lakh population. For the Smart Cities, the interventions are a pan-city initiative and not limited to the ABD area only. A total of 113 cities registered for the challenge. Participating cities undertook pilot

projects, citizen surveys and training in capacity building workshops. The Challenge is conducted in two phases. 38 cities submitted their proposals towards Phase 1 of the Challenge in July 2021. 30 cities of these have been shortlisted and will be evaluated to identify winners for Phase 1 in October-November 2021.

Transport 4 All (T4All) Challenge - The Ministry of Housing and Urban Affairs launched the Transport 4 All challenge in collaboration with ITDP on 15th April 2021. The Challenge aims to bring together cities, citizen groups, and startups to develop solutions that improve public transport to better serve the needs of all citizens.

At the core of the Challenge are citizens who will not only define the problems for which solutions shall be created but also help startups and cities to refine the solutions to meet their needs. The first edition of the Challenge focuses on digital innovation. Cities and startups will receive guidance to develop and test various solutions, learn from them, and scale them to build people's trust in public transport and enhance their mobility. The solutions will make public transport—formal as well as informal— safe, convenient, and affordable for all. All the Smart Cities Mission cities, capitals of states and union territories (UTs), and all cities with a population of over 5 lakhs—are eligible for the Challenge.

The Transport4All through Digital Innovation Challenge comprises three stages:

- Stage I Problem Identification: Cities, with the support of NGOs, identify key recurring problems that citizens and public transport operators face
- Stage II Solution Generation: Startups develop prototypes of solutions to improve public transport with inputs from cities and NGOs
- Stage III Pilot Testing: Cities engage startups for large-scale pilots and refine the solutions based on citizen feedback

Cities, as part of the challenge shall form a Transport4All Task Force (TTF) consisting of key stakeholders vis. Municipal Corporation, Smart City SPV, city bus undertaking, metro and suburban rail, regional transport office, traffic police, road owning agencies, Intermediate Public Transport (IPT) unions, NGOs, and academic institutes working in the field of sustainable transport. (www.transport4all.in). A total of 130 Cities (all 100 smart and 30 non-SCM cities) have registered for the Transport4All Challenge so far.

EatSmart Cities Challenge- On 15 April, 2021, we launched the EatSmart Cities Challenge to scale up the Eat Right India approach to city level. The Eat Smart Cities Challenge is envisioned as a competition among cities to recognize their efforts in adopting and scaling up various initiatives under Eat Right India by strengthening the food safety and regulatory environment, building awareness among the consumers and urge them to make better food choices in India's smart cities.

Globally, the concept of an 'EatSmart City' is in the initial stages of development and India has the opportunity to play a pioneering role in shifting the thinking around these critical issues.

EatSmart Cities challenge is meant to motivate cities to develop a plan that supports a healthy, safe, and sustainable food environment supported by institutional, physical, social and economic infrastructure along with the application of smart solutions to combat food related issues.

As a part of this challenge, cities will create a strategy aligned to the Eat Right India movement in consultation with stakeholders and citizens.

In closing, what do you think the 100 Smart Cities have generated as a learning platform for the next wave of implementations — with faster, smoother and more efficient outcomes

100 Smart cities are lighthouses, which are going to trigger innovative and more citizen centric urban development.

India is big, and its urbanization is going to be its backbone of its economic growth. To this end, a guidebook on 'Making a City Smart- Learnings from the Smart Cities Mission' encapsulates these learnings from the Smart Cities Mission.

It can help other cities understand the what, why and how of embarking on the road to being a 'smart city'.

The outcomes of Smart Cities Mission will be the star in this contribution.

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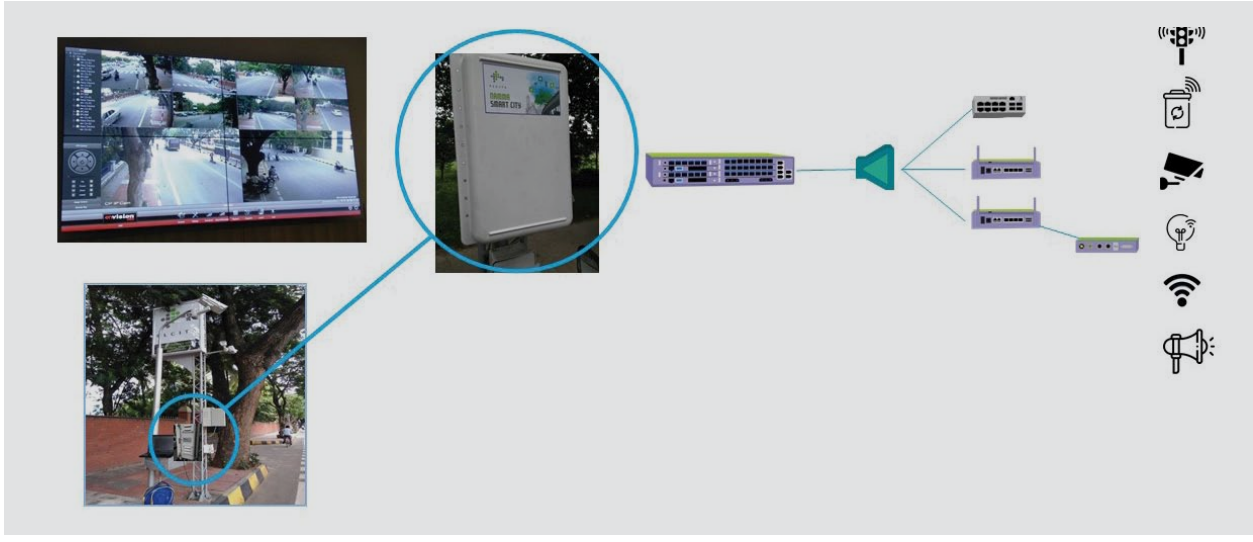
Smart Cities – A Success Story

Some amazing innovations have come through the smart city projects in India



BY S. KRISHNA

The Smart Cities Mission aimed to promote cities that provide core infrastructure, clean and sustainable environments and a decent quality of life to citizens through 'smart solutions'.

Towards this, a holistic strategy based on a platform-based approach is slowly developing. The book "Platform Revolution: How Networked Markets Are Transforming the Economy and How to Make Them Work for You" describes this effect:

"A platform is a business based on enabling value-creating interactions between external producers and consumers. The platform provides an open, participative infrastructure for these interactions and sets governance conditions for them...enabling value creation for all participants.

A great example is the infrastructure created by Tejas networks for the Electronic City Industrial Township Authority (ELCITA) in Bangalore. They needed reliable bandwidth connectivity to run various smart city services. Tejas deployed its gigabit ethernet passive optical network (GPON) Terminals and Ethernet switches across more than 100 poles. They were for backhauling video, providing Wi-Fi, traffic surveillance, Public announcement systems, Smart lighting, smart waste management and integrating IOT devices into a network operating center or NOC. The same infrastructure will be extended later to provide other smart city services with no change in the network. It is a connectivity platform of multi-dimensions.

Digital Transformation (DT) of Indian Cities

Digital transformation of the selected Smart Cities have started in earnest and goes beyond connectivity.

DT requires the use of data to create actionable intelligence. Cities need to reach and engage residents, and make them more informed, more connected to the community they live in. City administrators are faced with the challenge of managing their services better. Data must be freely moved or shared whenever, wherever, and in whatever format it is needed.

The Open Data Initiative was an outcome of this requirement. The Indian Urban Data Exchange (IUDX) was born out of the need to enable data exchange between various city departments, government agencies, citizens and private sector. IUDX helps cities to use data

"Our Smart City solutions are used to provide a unified management experience for city infrastructure, simplifying control room operations and integration."

Ashish Wattal, Director, Public Sector, Sales – Cisco India

intelligently to address complex urban challenges. IUDX is completely open source, based on an underlying framework of open standard APIs, data models, and the security, privacy and accounting mechanisms that will facilitate its easy adoption across the digital ecosystem.

The multiplication of IoT (Internet of Things) introduces complexities in data management, analysis, and governance:

- Massive volumes and intermittent data streams from a variety of legacy and new devices
- Data from varied sources – sensors, connected mobiles and vehicles and electricity grids and traffic lights
- The formats and schemas are all different

IUDX is helping break the data silos to enable sharing of public and privately owned data. And also for creating compelling use cases to address major civic issues.

Then there is also the unified monitoring and management of data. Smart Cities have given an impetus to the Integrated Command and Control Centres (ICCCs) in each city. ICCCs, are designed to enable seamless monitoring in real-time. Initially it was aimed at monitoring water and power supplies, sanitation, traffic movement, integrated building management and Internet infrastructure. They have evolved into monitoring of various other parameters like CCTNS (Crime and Criminal Tracking Networks and Systems) under the Ministry of Home Affairs (MHA).

The Pandemic gave the ICCC a completely new life. For example, Cisco, the networking giant, collaborated with the Gurugram Metropolitan Development Authority (GMDA). "Our Smart City solutions are used to provide a unified management experience for city infrastructure, simplifying control room operations and integration," says Ashish Wattal, Director, Public Sector, Sales – Cisco India. "We have partnered with the GMDA to support the city's futuristic ICCC, which is designed to enhance citizen safety, optimize public infrastructure, and manage traffic."

The platform allows city administrators to collect and integrate data from multiple sensors and sources, enabling them to use data analytics to optimize city operations, improve governance, and accelerate decision making.

Within the ICCC, GMDA is using its solution to align parking, lighting, waste management, surveillance, e-governance, and city planning systems.

Bhopal

The Bhopal Smart City Development Corporation Limited partnered with Bharti-Infratel, Ericsson, and HPL for its efforts to create Smart, Connected, and eco-friendly Communities. One of the highlights of this project is the deployment of smart poles and street lighting as a multi-application platform.

The ubiquitous street pole for lighting, which is usually ignored for its ugly designs has been redesigned as a multi-application smart pole with the capability to accommodate multi-operator telecom base stations to enhance mobile coverage.

It also has inbuilt surveillance cameras, Wi-Fi hotspots, interactive digital signage for traffic and business, environment sensors & Cloud controlled EV charging. All of these poles are connected via a citywide optical fiber network to a state-of-the-art control and command center. And, it works as a streetlight too.

Sounds amazing? It doesn't stop here. They also have an app "Bhopal Plus" for providing citizen services. The Common platform on this application enables a dynamic marketplace for the citizens of Bhopal to avail various kinds of domestic and household services with quality and efficiency. A smart parking initiative allows citizens to pre-book a parking slot, making it easier to locate it and pay for it via different modes. All buses are equipped with

> We have partnered with the GMDA to support the city's futuristic ICCC, which is designed to enhance citizen safety, optimize public infrastructure, and manage traffic.

a GPS-based Automatic Vehicle Location System (AVLS) and connected to a Central Control and Command Center. All these initiatives make Bhopal a truly shining example of the smart city movement in India.

Gujarat

In Gujarat, GIFT City became India's first greenfield Smart City to achieve the Indian Green Building Council (IGBC) Green Cities Platinum rating. The futuristic infrastructure development at GIFT City has won several awards and accolades at various forums. The infrastructure developed in GIFT City, such as District Cooling System (DCS), Automated Waste Collection System (AWCS), and Underground Utility Tunnel, contributes to making the city ready for a sustainable way of living. GIFT city has embraced water management through a 35% reduction in potable water and treatment & reuse of 100% wastewater. GIFT City has also installed an automated waste collection and segregation plant.

Chandigarh

Chandigarh has several initiatives to promote sustainable development as part of the smart city project. One of them is the Tertiary Treated (TT) Water SCADA project that is being implemented to monitor the quantity and quality of Recycled Water to save the precious water resources being used for irrigation purposes in the city.

Presently, the TT Water is being supplied to all the sectors without any automatic monitoring resulting in a non-equitable distribution of TT Water. The SCADA system enables monitoring of residual minerals and pH levels and Residual Chlorine as well as Flow measurement, Pressure measurement etc. by installing various IOT sensors and analyzing equipment.

New Delhi

The New Delhi Municipal Council is working towards launching a unique addressing solution for urban properties by allotting a unique digital door number to each property under their jurisdiction. The idea is to integrate and expedite the provision of municipal services and enable a more efficient gathering of data on these properties.

Each property will be given an alpha-numeric code that will contain information of the main road, sub-road, landmark, building and floor of the address, and will be affixed with a radio frequency identification and QR-based plate.

In renewable energy, NDMC has developed Solar Integrated Lighting Poles, Solar Bus Queue Shelters and Solar Trees to enable clean production of energy using the urban infrastructure. Smart nurseries aim to improve the availability of high-quality seedlings and plants by controlling weather conditions.

Smart meters are part of the overall Advanced Metering Infrastructure solution (AMI) that measures and records consumers' electricity usage at different times of the day and send this information to the energy supplier through over-the-air communication technology. This gives consumers better access to information and enables them to make more informed decisions on the use of electricity in their homes, leading to reduced power wastage, and providing long-term carbon and financial savings. NDMC has completed the project of replacing 50,000 conventional electricity meters with smart meters and become the first distribution company in India to implement a 100 percent smart metering solution.

In the field of smart healthcare, NDMC has deployed e-Hospital, a hospital management system. It is a workflow-based ICT solution for Hospitals specifically in Government Sector. This software covers major functional areas like patient care, laboratory services, workflow-based document information exchange, human resources, and medical records management of a Hospital. It is deployed in cloud infrastructure to manage multiple hospitals seamlessly.

New Delhi leveraged high end Cisco networking technology to set up an Urban Observatory with the Ministry of Housing & Urban Affairs (MoHUA). The observatory uses data analytics to optimize city operations and improve governance.

Cisco deployed its WebEx and Centralized Urban Observatory Software Platform with Analytics and Artificial Intelligence. This proved to be extremely useful during the COVID-19 pandemic. The ICCC (War room) in New Delhi was a first-of-its-kind that used data analytics and collaboration tools to monitor, measure

and analyze COVID-19 data for preventive / corrective containment actions.

It served as a central management node connecting various government ministries, emergency responders, hospitals, quarantine centers, etc. for on-ground actions. In addition, it integrated with smart-city infrastructure across the country to collect and analyze data.

The digital dashboard was replicated in Chhattisgarh, Karnataka, and Telangana and 20 other cities of India (for lockdown protocols, density monitoring, agency coordination, etc.).

Bengaluru

In Bengaluru, the Electronics City Industrial Township Authority (ELCITA) partnered with technology partner IISc, platform partner Wipro, network partner Tejas Networks, Velankani, Bosch, Siemens, Vedionetics, Mindtree, among other companies to provide an "affordable" smart city that is relevant to citizens. The Smart City initiative comprises of e-Governance, Smart lighting, Smart water/waste, management, Smart parking, Smart surveillance, Traffic management, Waste management, Complaints management through citizen App, Town cplanning, among others.

It is built on a Combination of IoT devices with Apps from vendors and locally developed Apps for specific data. One example of the service being provided to citizens is "Dynamic Syncronized Signals" which utilises Google Maps technology to measure traffic volume and speed and regulates the timing of traffic lights. This helps commuters reach their destinations in time and with fewer traffic hiccups.

Rail

The Delhi to Meerut regional rapid transit system (RRTS) is the first in a phased development of a high-speed rail network. Aims to enable sustainable economic and social development through enhanced connectivity in Delhi and the surrounding districts. The fully redundant private network, based on the Nokia Modular Private Wireless solution (MPW) including its latest Radios, Evolved Packet Core, IP/MPLS backhaul routers, Group Communication platform for mission-critical push to talk/video (MCx/GC), and Network Services Platform (NSP) management, will span the 82 km rail route which incorporates 25 stations.

The private network is being deployed for the European Train Control System (ETCS) Level 2 & 3 signaling as well as automated operation (ATO), which enables trains to use radio signals to continuously receive their movement authorities and to report their exact direction and position. The introduction of LTE/4.9G technology for ETCS is an important asset for railway operators and will pave the way for a smooth transition to FRMCS (Future Railway Communication System). Expected to be fully operational in 2025, the low-emission RRTS will transport more people at average speeds of 100 kmph to reduce travel time and road congestion.

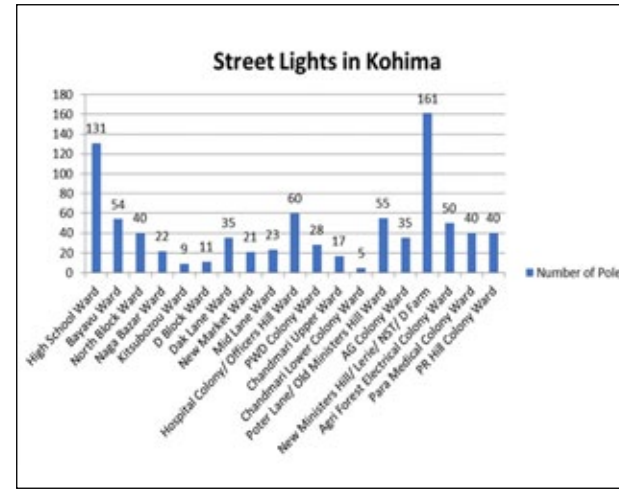
These are some truly great examples of the amazing innovations happening on account of the smart city projects in India.

KOHIMA

Street lights play a very important role in improving security. To understand the street light coverage in the city an analysis was carried out by Kohima Smart City.

Analysis

Out of 19 wards that exists in the city, some have more street lights as compared to other wards. And the average number of poles in each ward in the city is 44, with only 5 wards having more than average number of poles.



Kohima is implementing an Intelligent Motion Sensor Street Lighting Control System that automatically activates when a car or a pedestrian is noticed in the area is being deployed. The solution is cost-effective because if there is no activity in the area, the light is automatically adjusted to an optimized minimum illumination level. A backbone consisting of Smart Sensors Wireless Network (SSWN) and Central Street Light Management Network monitors and provides uptime even in the remotest areas in Kohima. This is helping improve Street Light coverage with lower operating costs.

> One example of the service being provided to citizens is "Dynamic Syncronized Signals" which utilises Google Maps technology to measure traffic volume and speed and regulates the timing of traffic lights. This helps commuters reach their destinations in time and with fewer traffic hiccups.

Smart Data Case Study – Fitness — Pimpri Chinchwad
The Pimpri Chinchwad Municipal Corporation (PCMC) has built over 85 gyms which provides gym services such as strength and conditioning, weightlifting, cardio, zumba, combat centres, and similar other services.

The vision of PCMC gyms is to provide the people of its area easy and affordable access to fitness centres.

Through its Public Gym Services, PCMC wanted to be the first urban local body to have setup easily accessible gym facilities, at such a large scale, for its residents at highly concessional rates.

One of the oldest PCMC gym running is 39 years old and was started in the year 1983. The PCMC gyms are partly managed by the PCMC staff and partly managed by private parties. There is a cap on the maximum chargeable membership fees for the gym operators.

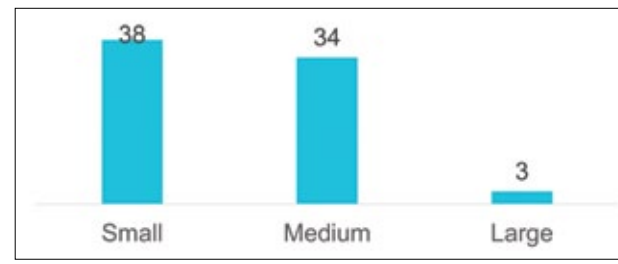
PCMC wanted to understand how beneficial the gyms have been for its people and what are the areas of improvement to make it a successful first of its kind public gym model. However, the challenge was that there was no real-time data.

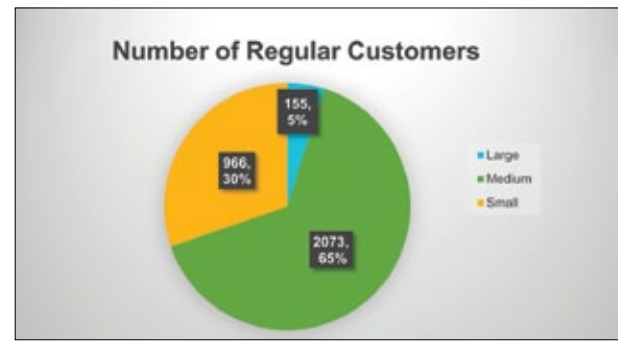
To understand its impact the PCMC decided to assess the current state of the gyms in the PCMC area and prepare an analysis report along with a recommendation report for determining the action plan.

PCMC Gym analysis study
The study was launched in the month of September 2021 and followed the following procedure:

Entries from 75 gyms were received and analysis conducted. The data collection process involved lot of parameters, out of which Facility Area (sq ft) was shortlisted as the key indicator which can be used as a centre point to classify Gyms in to 3 categories.

Categorising the gyms helped in understanding the ideal requirements of a gym, popularity of each type of gym, and preference of the customers, whether the 'Small' gym had more footfalls or 'Large' gyms had more customers.





Going forward, the PCMC can utilize the data points to construct a successful business model for its gyms by addressing the gaps. Medium and Large gyms are the better segments to invest time and resources, and where possible Small Gyms can be converted into one Medium or Large gym to increase the utilization rates of their facilities.

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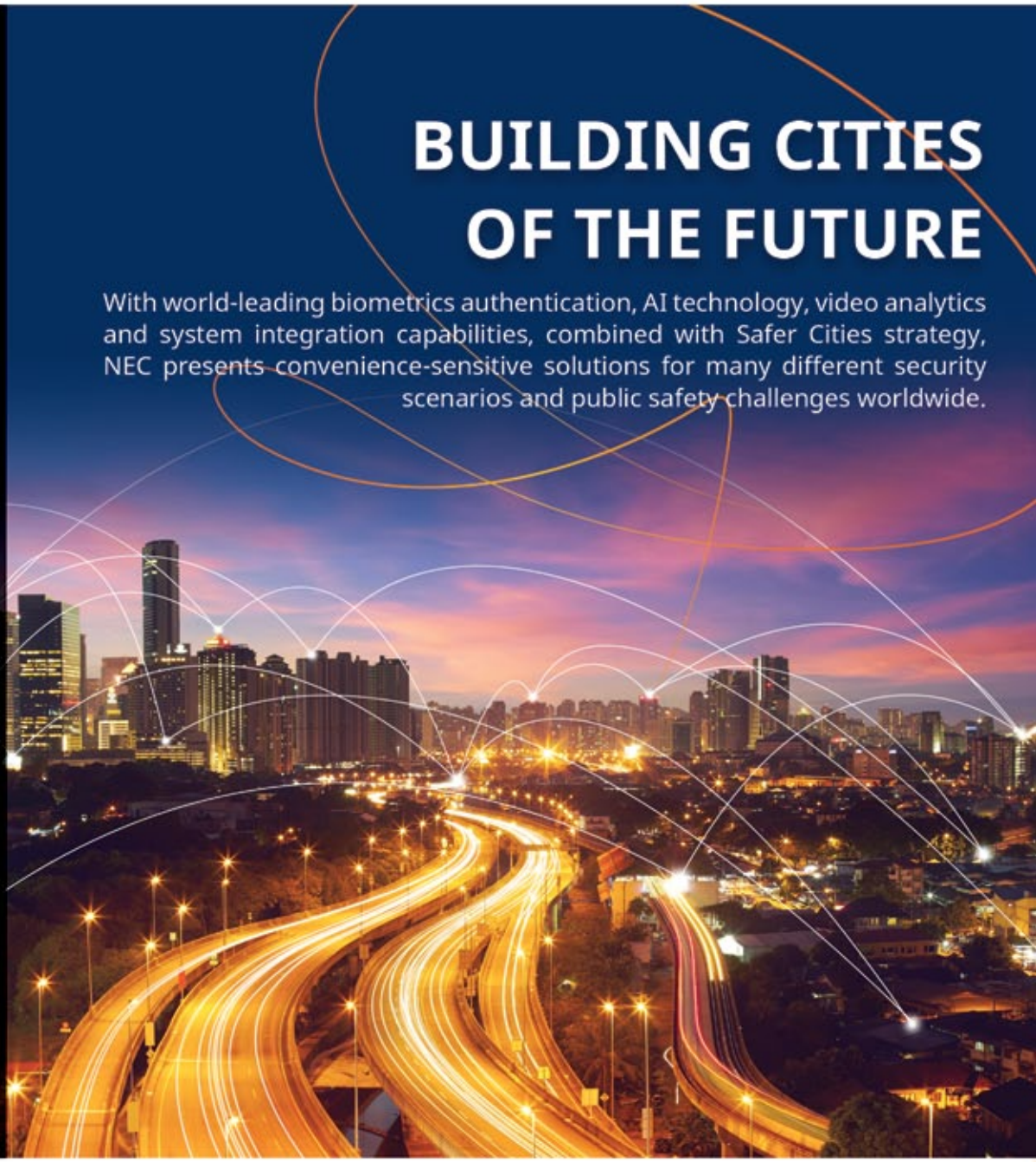

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Smart Cities need to adopt a National Standard for Device Eco-System

CCSP is the CDOT's Common Service Platform for IoT. It is based on oneM2M standard. CCSP is a software platform which contains the horizontal Common Service Layer for IoT applications in multiple industry use cases

BY DR RAJKUMAR UPADHYAY

Smart Cities are one of the biggest users of machine to machine and Internet of Things (M2M/IoT) applications. Applications inclusive of but not limited to Smart Homes, Intelligent Transportation System, Smart Parking, Smart Street Lighting, Solid Waste Management System are all examples of M2M/IoT use cases - very essential components in a Smart City. The Global thrust towards making cities smarter has also been a huge boost for the M2M/IoT industry.

The Smart Cities Mission of the Government of India also backs M2M/IoT solutions for improving the quality of infrastructure and citizen services.

India has played a very big role in the International Standards for M2M/IOT.

ENVIRONMENT	SAFETY	TRANSPORATION	UTILITES	BUILDINGS
By way of new sensor networks the accurate monitoring of environmental conditions like pollution levels, wildlife counts, and water runoff all become possible.	Structural Health Monitoring of buildings, bridges and dams as well as advanced warnings systems in emergency situations can now be put in place.	Through sensors embedded in roadways and street lights, real-time transit and traffic can be managed for the purpose of reducing travel time and fuel inefficiencies.	A smart utility grid will empower end users to be more aware of their energy uses, and allow utility companies to deliver only as much energy or water as is required.	Smart Buildings utilize monitoring devices that track usage and empower users and service providers to better control and reduce electricity demands.

Cities becoming Smarter by use of Sensors, Networks & Applications

Massive Growth of IoT/M2M

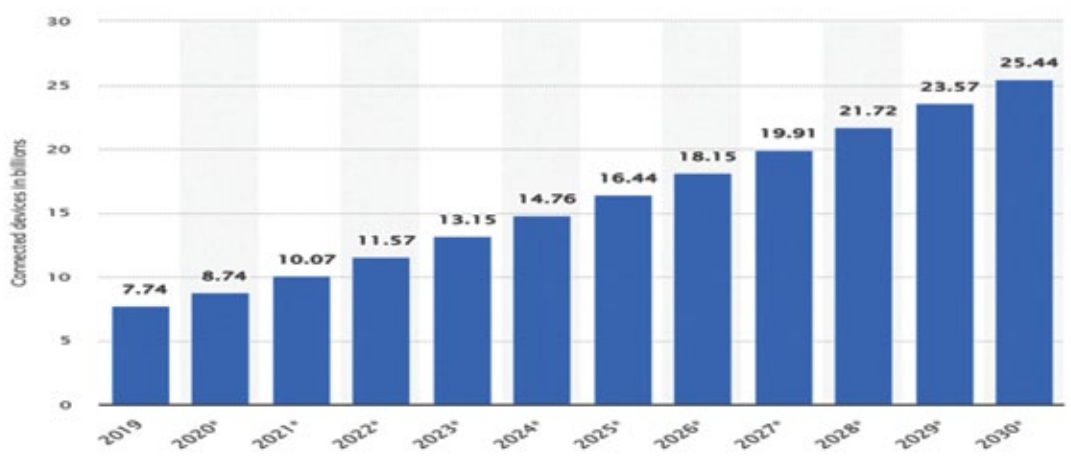
In the past few years, worldwide growth in Internet usage and broadband (with declining costs) have given a boost to IoT/M2M. According to Statista, the number of IoT devices worldwide is forecast to almost triple from 8.74 billion in 2020 to more than 25.4 billion IoT devices in 2030. In 2020, the highest number of IoT devices were found in China (3.17 billion devices).

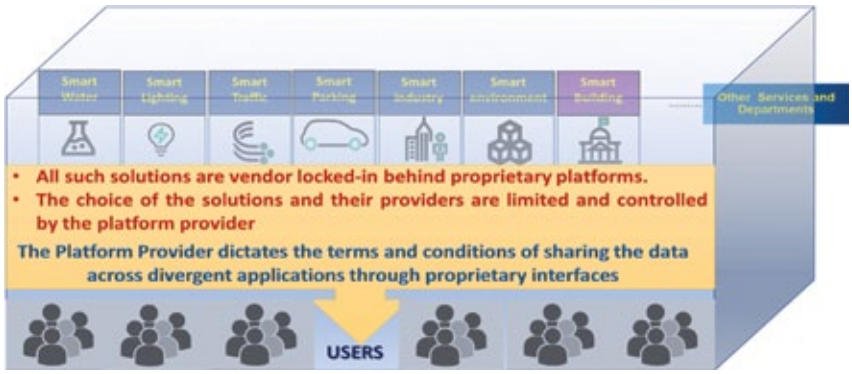
Embedded M2M devices have also acted as a catalyst. From just a technology in industry and manufacturing sectors, IoT/M2M use is now part of every household gadget - from refrigerators to light bulbs.

Key bottleneck - vendor Lock-In

Smart Solutions in Smart Cities range from connected public transport, traffic monitoring, water level / flood monitoring to video surveillance, connected streetlights, weather /air quality / pollution monitoring, smart metering for water/electricity and fire / smoke detection. However, Smart Cities have faced a major bottleneck in deploying these smart solutions. This is due to Vendor lock-in.

Number of IoT connected devices worldwide 2019-2030 (Courtesy : Statista)





State of IoT use cases in Smart Cities

Proprietary, non-standardised devices lack interoperability (data sharing becomes difficults) and this creates a challenge.

Lack of Standardisation

The current IoT/M2M landscape consists of vertical applications. Proprietary IoT/M2M platforms/solutions all operate in vertical, functional silos; each has its own specific hardware and software and dedicated controls. The network of sensors thus traps users into a vendor locked-in environment without scope for reuse or interoperability between sensors, devices and data sharing thus raising the total cost of ownership (TCO).

To reduce both the CAPEX and OPEX of IoT/M2M applications inter-operability of standardised platforms is necessary.

Essential requirements of all M2M/IoT Applications

For a cost effective and efficient deployment of M2M/IoT Applications, irrespective of type and target consumer, the following features are essential:

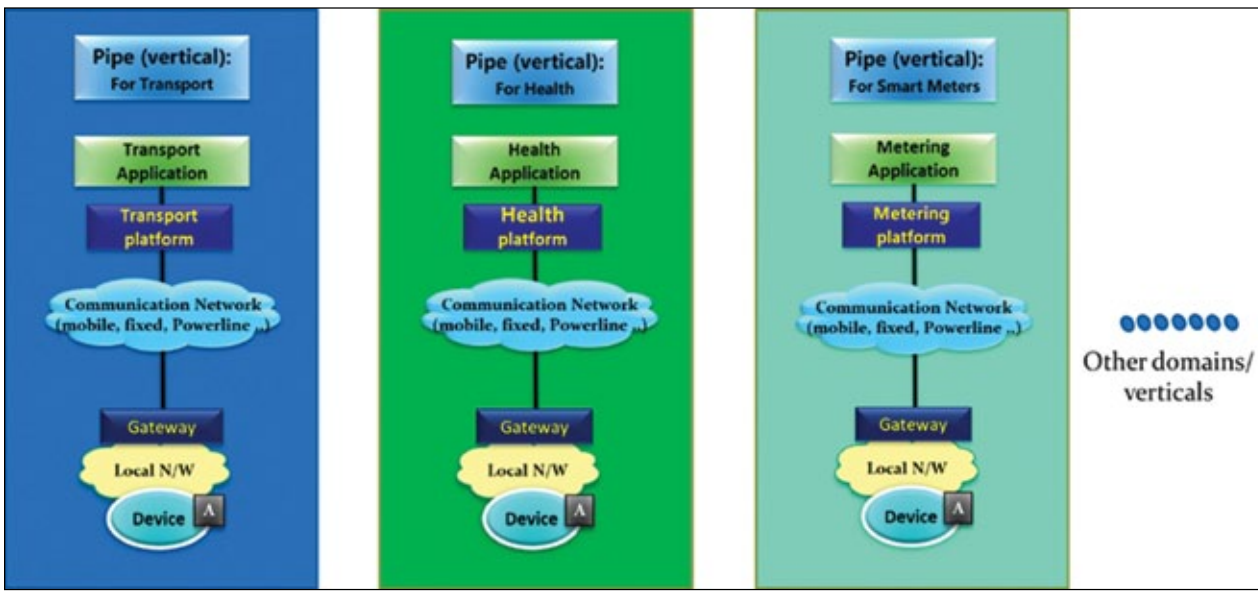
Interoperability

• To avoid Vendor Lock-in and for sustainable, large-scale deployments of M2M/IoT Solutions, interoperability of applications, devices, networks and semantics is vital.

Security and Deployment of only authorized devices

- A standardized and robust security framework should be mandated including mandatory testing and certification. Device Security, Authentication, Authorisation, Communication Security, Data Integrity, Data Privacy and Lawful Interception are core to M2M/IoT deployments.

- In IoT/M2M Solutions, the sensors and actuators play the most vital role i.e., the role of "data generators" and that of "Acting upon it". Needless to say, the situation can be catastrophic if these are compromised. It is therefore necessary to have a standardized framework where no unauthorized device (sensor or actuator) — or even application — is allowed to communicate. In a proprietary vendor locked-in scenario such factors are very difficult to address.



Current Landscape of IoT/M2M solutions

Data Sharing

- In real world M2M/IoT Deployments, it is vital to have data sharing among divergent applications. This not only eliminates the need for exclusive and duplicate deployment of sensors, but also reduces burden on network resources. Data sharing enables efficient management of divergent applications. In proprietary implementations, such sharing is controlled by the vendor.

Seamless integration of divergent applications

- In real-world implementations, there would be a variety of M2M/IoT applications even if they are catering to the same vertical. For example, a smart street light application may be using devices and technologies which are suitable for one geographical location. Another smart street light application may use a different technology. It is thus necessary that they integrate with each other seamlessly for management of these devices (e.g. street lights) to become uniform.

Faster Development and rollout of new applications

- Any app development which demands a painstakingly long development lifecycle is unacceptable to smaller players (start-ups). It means higher cost and loss of competitiveness. Only the large players are able to push dated applications and technologies to the market in a vendor locked-in scenario. Moreover, vendor-locked in solutions are hardly cost-effective and generally lack innovation. And the sustainability of a solution lies on its ability to accommodate change and not curb innovation. A standard platform promotes innovation and economies of scale.

oneM2M: The Global Standard

It is in this context that oneM2M, the global standardization body for IoT/M2M was formed. It consists of eight of the world's preeminent standards development organizations: ARIB (Japan), ATIS (USA), CCSA (China), ETSI (Europe), TIA (USA), TSDSI (India), TTA (Korea), and TTC (Japan), together with two industry fora or consortia (GlobalPlatform, OMA SpecWorks) and over 200-member organizations.

oneM2M has developed a horizontal framework on open standards and API (Application Programming Interfaces). It provides common service functions needed by all business applications and divergent vertical use cases. It exposes the standards compliant APIs for use by developers to build sector specific applications faster -they are able to focus only on the business application and not waste energy and resources in developing interfaces. oneM2M is based on open standards. It prevents vendor lock-in.

India's Role in the Global and National Standard for IoT/M2M

Since 2013, the Department of Telecommunications (DoT), Government of India, understood the need for standards in the IoT/M2M ecosystem. The Telecommunications Engineering Centre (TEC), was asked to work on standardization. TEC started the IoT/M2M standards discussion by forming working groups with industry participation. Many technical reports were released. India's own Telecom SDO, TSDSI (Telecom Standards Development Society of India) comprising of operators and manufacturers, academia and R&D organizations was also formed on 7th January 2014 to take up the standardization activities at a global level. They work with Global Standardisation initiatives like oneM2M and 3GPP. As a member organization of TSDSI, Centre for Development of Telematics (C-DOT), the R&D unit of DoT, is a member of oneM2M. C-DoT has contributed to the global standard. The oneM2M specifications Release 2 were transposed by TSDSI and were sent to DoT with a recommendation to adopt the same as a National Standard. TEC was entrusted by DoT with the task of adoption of oneM2M as National Standard for IoT/M2M.

Following the established standardization process, TEC carried out detailed deliberations with the Govt., industry and academia in the Consultative Committee and submitted its report to the Telecom Standards Advisory Committee (TSAC) which recommended in favour of adoption. TEC vide its OM no. 19-1/2019-STD/TEC/2 adopted oneM2M as the National Standard for IoT/M2M. Currently TEC is working on the adoption of Release 3 of oneM2M specifications.

Bureau of Indian Standards (BIS) has also published the IoT System Reference Architecture standard under LITD 28 [IS 18004 (Part 1): 2021]. This standard is also based on the National Standard of IoT/M2M adopted by TEC.

C-DOT's Common Service Platform

CCSP - CDOT's Common Service Platform for IoT based on oneM2M standards is a software platform which contains the horizontal Common Service Layer for IoT applications of many domains and multiple industry use cases. CCSP offers a standards-based approach to develop and deploy solutions in IoT/M2M, significantly

reducing development time and deployment lifecycle. CCSP is agnostic to underlying hardware, Operating Systems or connectivity technologies and enables secured data sharing between divergent applications using standards based interfaces.

Features of CCSP

CCSP supports 12 Common Service Functions (CSFs) as per oneM2M Release 3:

- **Registration -** functionality for an application and its instance to register to the CCSP for using its other CSFs.
- **Security** - Identification, authentication, and authorization. Supports PSK and Certificate based security.
- **Group Management -** Manage a group and its members and perform Group related bulk operations
- **Subscription & Notification -** Subscribing to data and produce notifications to defined applications, whenever data of this entity changes
- **Transaction Management** - Scheduling of a transaction, locking and unlocking of resources targeted by a transaction, the atomic and consistent execution of a transaction on targeted resources, the committal of successful transaction results, and the abort and rollback of non-successful transactions.
- **Device Management -** Management of oneM2M nodes by using the standard management protocols like TR069/LWM2M
- **Service Charging and Accounting -** Generation of Information element records for which of the command, which can be used for charging further.
- **Discovery-** Discover the entities created by one application to be discovered by another application.
- **Location -** Storing and providing access to location of devices.
- **Application and Software Management -** management of software installed on oneM2M nodes
- **Data management and Repository -** Data storage functions with the capability of aggregating large amounts of data, converting into a specified format and storing it for analytics and semantics processing
- **Semantics -** Association of semantics with the data and performing semantic based queries on it.

CCSP provides RESTful resource-oriented APIs (CRUD-N) and supports both XML & JSON data format. It also supports advanced functionalities like Flex Container, Service Subscription, Service Provider Restrictions, Time Series Data, Field Device Configuration, Announcement across oneM2M Nodes and 3GPP Interworking for Non IP Data Delivery etc.

Interfaces Supported

3GPP T8 interface supported,

- oneM2M Mca, Mcc interfaces supported over HTTPs, CoAPs and MQTT
- oneM2M based IoT Applications from C-DOT

Along with the CCSP platform, C-DOT has also developed various oneM2M based solutions and also assisted industry partners in the development of oneM2M compliant solutions.

Developed in-house (Deployed in C-DOT Campus)	Assisted partners to develop (Deployed in C-DOT Campus)
• Smart Living Application (Temperature, Humidity and Power monitoring & HVAC Control) • Canteen Feedback System, • Vehicle and Visitor Management • Emergency Alarm	• Fire Safety and healthiness monitoring application
Developed in-house (Prototype)	**Assisted partners to develop**
• Smart Street Light Application (both LoRa and 6LowPAN based) • LoRa based patient Quarantine System	• Traffic Light Control and Monitoring application

Conclusion

Non-standardised proprietary solutions in Smart Cities have locked them into proprietary ecosystems. This limits technology choice and increases costs. Vertical rollouts, where each IoT use case is propped up in a dedicated silo or use case-specific data exchange mechanism and single-use devices, do not scale.

Cities have to reorient towards greater cross-domain synergies. For this, it is essential that networks, devices and data are used for more than one purpose. Other functions like device management, security and communication management if shared by multiple IoT applications, makes it more robust and cost efficient.

By implementing oneM2M based IoT solutions along with CCSP, cities will be able to mix and match solutions from multiple vendors. This will create opportunities for start-ups and indigenous solutions developers. C-DoT is supporting startups in this effort to make applications and devices OneM2M compliant.

Dr Rajkumar Upadhyay, ITS, Ph.D. (IIMB), MBA (IIMB),M.Tech. (IIT- Roorkee), Executive Director, C-DOT

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IUDX and the Transformational Role of Data in Urban Sectors

The India Urban Data Exchange (IUDX) is an initiative created in partnership with IISc, Bangalore. It facilitates secure, authenticated and managed sharing of data amongst various data platforms. IUDX is deployed in 15 Indian cities and being rapidly rolled out in many more every month

BY DR INDER GOPAL

Getting control of data through a data exchange

Cities around the world have learned that they possess a new valuable asset – data generated by their various departments and agencies. An example being streams of data from Internet of Things (IOT) sensors (e.g. Air Quality, Traffic). Some of the data is demographic or geographical, others may be from municipal tax or property records, yet others are legal documents or registrations, and then there are historical data from archival sources.

Each set of data has its own security and privacy considerations, as well as commercial, monetary or subscription aspects. Cities such as Copenhagen and Manchester have taken ownership of their data assets by creating data exchanges, which are software platforms that allow controlled sharing of data by providing common ways of accessing and representing data. An important idea behind a data exchange is that data silos are actually not a bad thing as each silo often represents a domain-optimized service that performs that function very well. Instead of breaking silos or moving data en-masse into a central repository, this approach chooses to interconnect the disparate and distributed entities through a common data exchange. This provides a way for accessing data in a unified, common format, allowing for sharing of data

Cities such as Copenhagen and Manchester have taken ownership of their data assets by creating data exchanges, which are software platforms that allow controlled sharing of data by providing common ways of accessing and representing the data.

> A data exchange allows the owner of the data to strictly control sharing, define who has access, the policies and pricing models. An open data platform, on the other hand allows open access to all.

between different departments in a city, as well as opening up data for third party developers to create innovative new applications and citizen services. In addition, there is an opportunity for third party providers of data, or third-party providers of data analytics or data annotation, to participate in what becomes a data marketplace.

It is important to understand the distinction between a data exchange and an open data platform (such as data.gov.in). A data exchange allows the owner of the data to strictly control data sharing and define which entity has access the datasets. It is also possible to define access policies and data pricing models. An open data platform, on the other hand allows open access to all comers, eliminating control of who gets access. A data exchange can increase dramatically the amount and type of data that will be shared as the data providers will retain control of their data.

The IUDX initiative

The Smart Cities Mission within GOI Ministry of Housing and Urban Affairs is committed to incorporating data-intelligence in addressing urban challenges of present and future. The India Urban Data Exchange (IUDX) is one such initiative created in partnership with IISc, Bangalore. It facilitates secure, authenticated and managed sharing of data amongst various data platforms and helps cities to strategically focus on unlocking the power of urban data in key sectors. IUDX is deployed in 15 Indian cities and is being rapidly rolled out in many more every month. IUDX is completely open source, based on an underlying framework of open APIs, data models, and the security, privacy and accounting mechanisms that will facilitate, easy and efficient exchange of data among disparate urban data silos. IUDX draws on ideas and, where feasible, code, from best-of-breed global projects such as Fiware. However, IUDX is heavily skewed towards the Indian ecosystem, cultural norms, city nomenclature, payment and identification systems, etc. and therefore the solution is particularly suitable for Indian Smart Cities.

Stakeholder Value

It is expected that all stakeholders in the Indian Smart City ecosystem will gain from the initiative. Within each of the cities, citizens and the community will benefit through the availability of better, more innovative, and cheaper applications and services. The cities themselves will benefit from the reduced development cost and faster development times enabled by a standard platform, together with the ability to choose vendors freely and avoid vendor lock-in.

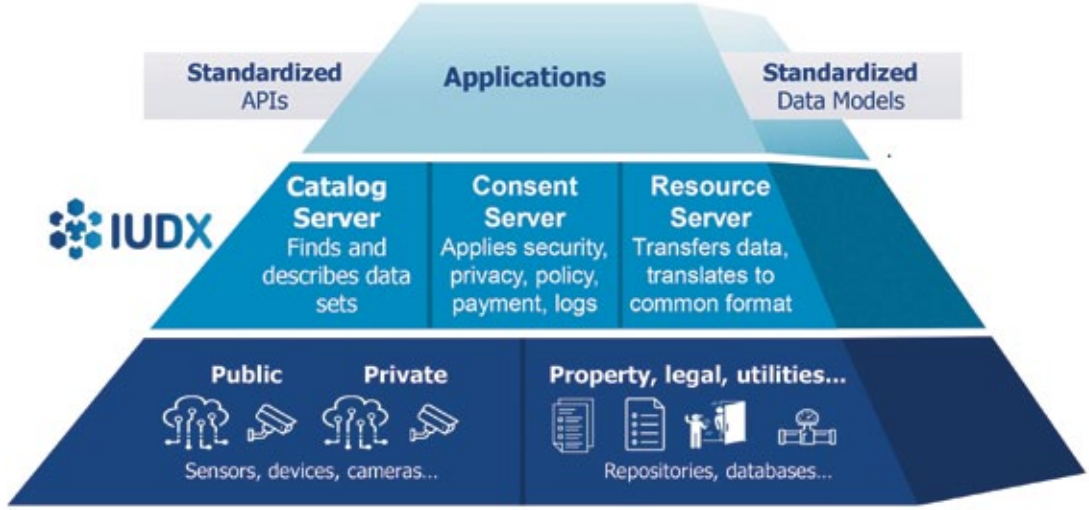
They will see new source of revenue through the unlocking of data assets, and will unleash innovation from entrepreneurs and community, without any cost to themselves. Industry will benefit enormously through the improved ability to find skills and rapidly ramp up projects. They will also see reduced development expenses enabled by a standardized and open source platform, and be able to focus on innovation and differentiated value rather than design basic platform software. Start-ups, in particular, will benefit from the decrease in heterogeneity IUDX provides.

Third party sources of data (such as private apartment complexes) will have a new opportunity to share and monetize their assets. Academic institutions and research labs will be able to conduct more meaningful research by having direct access to a wide variety of data.

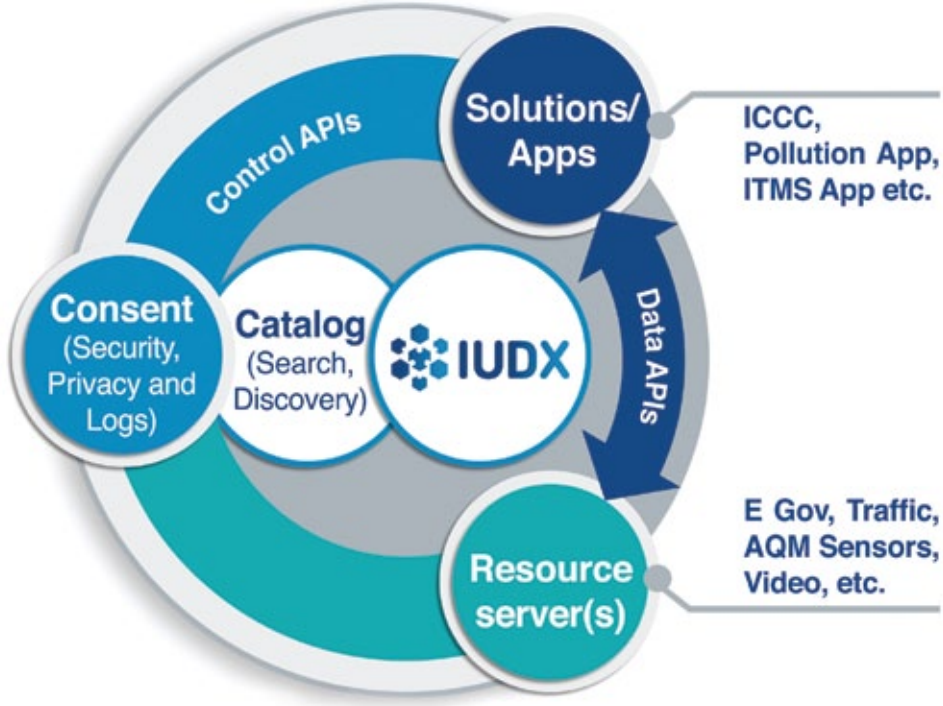
IUDX Overview

IUDX is an open source software platform that will facilitate secure, authenticated and managed exchange of data amongst various data platforms, third party authenticated and authorized applications and other data sources, data producers and consumers, both within a city to begin with and scaled up across cities eventually at a national level, in a uniform and seamless way. The platform provides full control to the data owners as to what data to expose and to whom. Built-in accounting mechanisms enable connect with payment gateways which will form the foundations for a data marketplace. The whole platform is developer friendly, via definitions of open APIs (Application Program Interfaces) and data schema templates (formats for interpreting data), so that a whole new application ecosystem gets created.

This is a simplified layered picture of the platform. The lowest layer is composed of a variety of data



The architecture below depicts the relationships and flows between these components.



sources, some public and some private, generating various forms of data. On top are a variety of applications that use the data to deliver useful services to the city and its citizens. These applications may be created by the city itself or by third parties such as industry partners or entrepreneurial start-ups. The applications will deliver services such as improving mobility, optimizing waste management, enhancing citizen safety, etc.

In the middle is the IUDX platform - a cloud based service that delivers three basic functions.

- A catalogue server that enables the identification and location of relevant data sets
- A consent server that allows ensures that only those that are allowed to share the data in accordance with policies defined by the data owner can do so, and

> In Varanasi, IUDX has enabled an application that uses data from garbage bin sensors, garbage cart and garbage truck GPS sensors and other sources to dynamically manage waste pickup for operational efficiency.

- One or more resource servers that transfer data from the data provider to the data consumer while transforming the data into a common data format.

IUDX enables sharing of data without losing control. It allows data to be located and identified through a catalogue server; ensures the data consumer is authorized access in accordance with the data provider's policies through the consent server; and ensures that data is transferred from provider to consumer in an understandable format through a resource server.

Governance and Operating Models

Since IUDX is set up as a collaborative project, broad city, industry, entrepreneur, community and governmental involvement is essential for the project to succeed. Industry partners will provide key technical skills and guidance for the project.

The operation of IUDX is governed by a board of advisors, a technical steering committee, and a data policy and ethics committee. To understand the need for three distinct governing bodies, we should understand that IUDX has three distinct aspects. IUDX operates as a non-profit company (it is technically a subsidiary of a non-profit operated by IISc) and it functions as any other company. Normal corporate governance is provided by the board of advisors as described below. IUDX will only succeed if there is a strong partnership and collaboration with the broad public data ecosystem. While some of the relationships will be ad hoc and informal, many are formalized as membership in a IUDX consortium. The IUDX consortium and its membership form the core of a community-based governance and operational model.

Use cases for implementation

IUDX has been successfully deployed in 15 pioneer cities with many dozens of use-cases that have brought great value to citizens. Three illustrative examples are discussed below:

Transit: The use of GPS devices coupled with apps to show real-time location of city transit busses and trains has been a resounding success in many cities across the world. IUDX has actually taken this one step further by using real-time fare collection data to enable an estimate current bus occupancy. In Surat, bus customers can now see whether or not seating is available in an arriving bus before attempting to board. This simple feature is credited with an increase of about 5% in ridership.

Solid waste: In the holy city of Varanasi, IUDX has enabled an application that allows the city to dynamically manage waste pickup for operational efficiency and for higher citizen satisfaction, saving at least 15% in overall cost. The application is based on real-time data from garbage bin sensors, and garbage truck GPS and loading sensors, and crowd sourced data to identify areas of garbage build-up.

Safe city: Using IUDX, the city of Pune has created a citizen safety app that uses real time data from smart street-lights, crowd density and crowd gender diversity, as well as data on nature of buildings on a street. Using this app, citizens can automatically find "the safest part" to walk through in Pune based upon current conditions.

Conclusion

The widespread use of the IUDX platform will dramatically enhance the power of new data-driven services available to citizens and administrators, and also increase the speed at which these can be created.

It is expected that the collateral benefit on the broader public and private sector eco-systems will be equally significant. As city administrators and private companies see the value of sharing their data, it is expected to create a virtuous cycle — more data will be collected and shared, which will enable new services to enhance the value of data collected. The ultimate beneficiary will be the urban Indian citizen and the quality of life in our cities.

Dr. Inder Gopal, CEO, IUDX program, Research Professor, Indian Institute of Science, Bangalore. Dr Inder Gopal has a distinguished research career with 20 patents and more than 70 technical publications. He has founded, built-up and successfully exited two venture-funded start-up companies.

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iValue Board announces the appointment of **Mr. Shrikant Shitole** as the **Chief Executive Officer**

SHRIKANT SHITOLE

iValue InfoSolutions, India's premium technology enabler, announced the appointment of IT Veteran Mr. Shrikant Shitole as its CEO. This appointment comes in as part of the strategic planning iValue InfoSolutions has designed for next 5 years. iValue, as a technology enabler is looking to extend the core business by expanding the portfolios based on relevance and investing in promising adjacent markets. iValue has planned to execute a framework consisting of three distinct phases that will unfold during the coming fiscal year which will be defending, extending, and transcending the core business. Shrikant's expertise around Cloud Services, Cyber Security, IOT, Smart City, Data Center Services, IT Infrastructure Planning & Management, and Outsourcing services will go hand-in-hand in creating a futuristic win-win situation.

iValue has been maintaining its growth at CAGR 40% YoY. iValue has been persistently investing on growth, allowing it to develop at 3X plus market growth rate in the last 10+ years. Its focus has been to address the complete needs around Data, Network and Application for Enterprise customers in a consultative way. Following the PE investment in 2019, iValue launched 3 main efforts to continue the company's growth trajectory:

- Expand geography coverage: iValue expanded to South-East Asia with a Singapore office. Appointed a CEO and team for South-East Asia covering SAARC markets with direct presence across Sri Lanka, Myanmar, Cambodia, Nepal, and Bangladesh along with Singapore & Malaysia.
- Technology investment: iValue established COE, training centres, and services connected to customer life cycle management in order to give a better customer experience and efficiency
- Exploring acquisition: iValue has been actively pursuing inorganic growth opportunities across India, SAARC, and Southeast Asia to accelerate next phase of growth.

With Shrikant's 25+ years of strong leadership experience iValue looks to turnaround the processes to grow at 5X times in next 5 years. Shrikant has been known in the industry for his B2B business management leadership roles across IT, Telecom, VAS, Software, and Cyber security industries, in his energetic 30+ years of experience. Shrikant, with his management skills, will focus on differentiating iValue to capitalise on the changing Cloud adoption & Cyber-Security landscape.

Welcoming Shrikant into the new role, Mr. Sunil Pillai, Founder & Managing Director of iValue InfoSolutions

SUNIL PILLAI

said, "I am delighted to welcome Shrikant as CEO of iValue. I have known him for a long time, and value his ability to develop, manage and grow product and solutions businesses. I look forward to leveraging his entrepreneurial abilities to disrupt existing markets and accelerate our growth into new segments. His strategic vision, as well as operational expertise and rigor, will be pivotal in the company's next phase of growth, and the iValue Board looks forward to working with him."

Shrikant takes over from Krishna Raj Sharma (KRS), who led iValue through a strong period of growth and raised capital from highly reputed private equity firm, Creador. KRS has steered iValue to become an enterprise company with a significant footprint in India as well as the Southeast Asian (SEA) markets. KRS moves on to overseeing iValue's Southeast Asian markets.

Welcoming the appointment, Mr. Varun Khandelwal, Director of Creador said, "I am pleased to welcome Shrikant into the role as Chief Executive. He has brought incredible experience, vision, and pragmatism to every organization he has been associated with. With his excellent leadership and business acumen, I am confident that iValue can become even more of a force to be reckoned with in the tech industry." Creador is a leading South- and Southeast Asia-focused private equity firm, with over USD 2bn in assets under management. The company invested in iValue InfoSolutions in 2019.

Accepting the responsibilities that come with the leadership role at iValue, Mr. Shrikant Shitole said, "Thanks to KRS and his able leadership, iValue has grown into a remarkable organisation. It would be an honour to learn, work, deliver, and expand on our strategic imperatives to transform and modernise our business, remove complexity for our partners, and become an indispensable organisation behind the numerous brands we support."

Mr. KrishnaRaj Sharma, Founder & Director of iValue InfoSolutions said, "We are excited to get Shrikant Shitole on board. I am confident that Shri, with his domain experience built throughout his career, is going to help iValue to create incredible value in the years ahead."

With the addition of SEA market as part of iValue's geographic expansion strategy, there has been a build-up on Consulting & Services business over the last 2 years. iValue has seen encouraging response from enterprise customers which has led iValue to continue its focus on Consulting & Services business for next few years. Apart from this, iValue will continue to focus on BFSI, Government and Enterprise practices which have always given iValue a heads-up around emerging needs at Top 100 customers. Analysing these demands will help iValue explore and on-board the best available technology OEMs to address the market needs on an on-going basis.

About iValue InfoSolutions:

All of the statistics about our magnitude, diversity, and years of experience, as impressive as they are, bear little resemblance to the ultimate measure of iValue: the differentiating impact we bring on to our fraternity. Here at iValue, we're constantly reinventing how we work and how we approach market constraints so that we can keep delivering meaningful, sustainable, and long-term results for our clients and communities.

We strive to be the best at everything we do, from assisting customers in realizing their goals to making a positive impact on society with numerous CSR drives apart from maximizing the performance of our employees. This inspires us to come together to make an impact that matters in the world.

A market leader in smart, cutting-edge technology solutions who assists businesses in managing, optimizing, and protecting their digital assets. iValue stimulates creativity as a leading Technology Enabler by providing comprehensive services that support Data, Network, and Application (DNA) management for businesses. Our "Go to Market" consists of niche, compelling, and complementary offerings that assist businesses of all sizes and verticals with their optimization and transformation efforts by leveraging the Customer Life Cycle and Product Life Cycle Adoption framework.

iValue is proud to have served for over 6000+ customers across industry verticals through 900+ Partners & direct alliances with 65+ "Best of Breed" Technology OEMs. iValue has a direct presence across 18+ locations covering South-East Asia & Africa continents with Consulting; Solutioning; Vertical & Horizontal focused teams, addressing Technology enablement, Pre-sales, Sales & Post-sales needs of Customer for Private, Public and Hybrid cloud needs. iValue ASEAN operates with HQ in Singapore, with local entities in Cambodia, Bangladesh, Sri Lanka apart from Nairobi (Kenya) office for Africa foray. We continue to grow at 4+ times market growth rates, at 50%+ CAGR for the last 13+ years.

For more information, visit **iValue** and follow us on **LinkedIn** and **Twitter**

India's 'Mission Transform Nation' – Moving into the Next Phase

As the Ministry of Housing & Urban Affairs develops a strategy for the next phase of smart cities in India, it will surely reflect on the lessons learnt by the hundred smart cities

BY JAGAN SHAH

The Union Budget 2022 has placed emphasis on building capacity to manage planned urbanisation in India. This may herald a long awaited recognition of urban planning as a means for achieving other development priorities, such as the shift to electric mobility, concepts like 'battery as a service', applications of drone technology and digital education.

The Gati Shakti programme, with its focus on ports, airports, highways, waterways and public transport, will also need to converge in urban areas and harness the power of planning.

Cities are the last mile or the drivers of most infrastructure systems; they are demand generators as well as consumers. They are embedded in the Government of India's approach to economic development.

Smart Cities

The Smart Cities Mission was conceived as a disruptor of business as usual, departing from the piecemeal and haphazard way in which infrastructure is usually built in Indian cities. It aimed at embracing an integrated approach whereby a substantial area is fully upgraded with the required infrastructure and services, leveraging information and communication technologies, geospatial intelligence, evidence-based decision-making and the principles of green, equitable and safe cities to deliver ease of living.

Different Set of Projects

Each city has a different set of projects based on the specific characteristics of each city's demography, economy and geography. By 2024, once the projects in 100 smart cities are completed, the Mission will have

> The 100 smart cities were selected through a competition that was open to all cities. As a result, we have cities ranging in size from ten thousand people to over ten million

delivered over 6000 projects with an investment of over 2 lakh crores, including projects for complete and safe streets, e-mobility, environment management, green open spaces, livelihood development, circular economy for waste, renewable energy generation, building energy management, water and sanitation, e-health, e-education, traffic management, energy efficient street lights, child-friendly parks, and innovation hubs.

ICCC

The integrated command-and-control centre or ICCC in the smart cities proved their worth during the first wave of the pandemic, when a large number of cities needed disease surveillance, contact tracing and quarantine planning.

Disruption was coded into the concept of the 'smart city' in India, which is meant to be a 'lighthouse' that offers successful models for replication across the over 4000 cities of the country.

The 100 smart cities were selected through a competition that was open to all cities. As a result, we have cities ranging in size from ten thousand people to over ten million, which other cities of similar size could learn from.

The Mission logo, a butterfly shaped out of pixels in tricolour, represents the "butterfly effect" that the Mission creates by devising local solutions that can be replicated far and wide. This process of transformation is already active, with cities learning how to plan, finance and deliver projects of the kind that they never handled before. Over the past six years, city governments have started talking about the 'internet of things', about 'smart' assistive technologies, universal access and safety and security. They have learnt about mitigating air pollution and flooding, built affordable housing and sports facilities, renovating old markets and upgrading heritage areas.

Scalabilty & Citizens Participation

Two aspects of the SCM have been neglected, and it can be hoped that the cities will address these in the next two years. The first is the scaling and replication strategy that each city was asked to propose in 2015, through which the successful pilots in one area would be replicated to cover the whole city. None of the cities have developed credible plans for abiding by this commitment.

The second, and related point, is that the buzz created by the SCM in 2015 was largely because the area to be made 'smart' and the projects to be executed in the city were identified through an extensive citizen-consultation process. This has not been sustained, with the result that the public in most cities is unaware of the SCM and thus uninterested in putting pressure on elected representatives and city governments to deliver the full scope of the smart city concept.

Lessons

As the Ministry of Housing & Urban Affairs develops a strategy for the next phase of smart cities in India, it will surely reflect on the lessons learnt by the hundred smart cities. It will also have to take into account the cumulative impact of other significant development over the past six years, including reforms and innovations in procurement, land use and real estate regulation, company law, revenue management and digitalisation, especially of land records and municipal service delivery.

The impact of 5G will be profoundly felt, allowing cities to deliver services more efficiently through remote sensing and automation, and augmented and virtual reality applications may become more commonplace.

Challenges

The Ministry will need to conceive a strategy that supports cities with economic recovery after the pandemic. Whether it is for scaling and replication or for innovation, cities will need to raise finance. Green finance may help them invest in productive assets that are disaster-resilient and carbon neutral. A bankrupt city is not a smart city. Every effort must be made to incorporate financial sustainability into the smart city model.

The first generation smart cities have grappled with the technical challenges of delivering infrastructure and services and improving public spaces. The second generation should focus on economic productivity and financial sustainability. Smart cities need to be atmanirbhar (self-reliant) cities.

Jagan Shah is Senior Fellow, Artha Global, and former Director, National Institute of Urban Affairs (NIUA)

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Aalok Kumar
President & Chief Executive Officer,
NEC Corporation India Pvt ltd

"Together with Airports Authority of India (AAI) NEC is implementing contactless boarding with Facial Recognition"

In Smart City solutions, NEC Corporation India stands out with its range of solutions. NEC India has been at the forefront of the SCM with cutting edge technologies – from AI and Face Recognition to Public Safety and Biometrics.

In a freewheeling conversation with Voice & Data ***Aalok Kumar, President and CEO of NEC Corporation India*** *shares interesting aspects of the Smart City implementations done by his company.*

The development and application of 'smart' solutions was aimed to overcome urban problems. What are the solutions deployed by NEC so far and how has it met these objectives of the Smart City Mission?

Driven by our Safer Cities strategy, NEC Corporation India has delivered turnkey solutions to make Indian cities safer. It not only empowered authorities but also enabled citizens to sleep peacefully.

In Karnataka and Kerala, we have enabled the police in reducing crime rates with the help of our Automated Fingerprint Identification System for criminals, which provides the ability to match unknown fingerprints against a larger database for criminal investigation. This solution was provided in over 1650 police/enforcement facilities across the states. This has helped in making Karnataka and Kerala the top two among all states in investigating and cracking criminal cases.

In 2021, we were awarded the mandate to drive Thiruvananthapuram's Smart City project. As the master system integrator for the city's Integrated Command and Control Centre (ICCC), this is slated for completion in 2022.

The Thiruvananthapuram smart cities project includes: One City Mobile App, Solar Scada, E Governance Application Support, Integrated Transit Management, a Smart Parking Management Solution, Environmental Sensor monitoring system and, Smart Water Management

NEC is the Master System Integrator of the Kalyan Dombivali Municipal Corporation (KDMC) Smart City Project. The mandate includes the implementation of a smart city operations center, environmental and flood sensors, as well as intelligent traffic management system using AI-based video analytics. It also covered the integration of smart city operations center with other existing systems, such as the intelligent transport management system, parking management system and geographic information system.

In October 2020, NEC India was selected by Saharanpur Smart City Limited (SSCL) as the master system integrator for the Integrated Command and Control Centre in Saharanpur City, Uttar Pradesh.

We have, along with Urban Mass Transit Company (UMTC), entered into a strategic alliance with the Ministry of Housing and Urban Affairs, Government of India to jointly develop and deliver intelligent mobility solutions in rural and urban India.

This initiative leverages NEC India's prowess in and stellar track record in the implementation of Intelligent Transportation Management Systems (ITMS) for state road transport corporations and other public transport operators.

We have deployed ICT solutions, such as Software as a Service (SaaS), Mobility as a Service (MaaS) and Data as a Service (DaaS) to enable a seamless, end-to-end

> The Union Budget 2022 announced plans for two lakh anganwadis to be upgraded into Smart Anganwadis.

multimodal travel experience for both inter and intra city commuters.

Finally we have partnered with Airports Authority of India (AAI) to facilitate contactless and quick boarding, including security checks and lounge access through a biometric based boarding platform based on Facial Recognition Systems. We use computer algorithms to capture specific details of a person's face and match it with a similar pre-stored image in the database.

This paperless and touch-less airport boarding system recognizes and tracks a passenger from arrival, security checks and boarding onward to departure. Developed with the Government of India's DigiYatra initiative, the installation of the cameras is currently in progress at Varanasi, Vijayawada, Pune and Kolkata airports. It is slated to be completed by June 2022.

What are the other paradigms in the Smart Cities mission that stand out in your view?

A most welcome addition to the Smart Cities Mission is its emphasis on climate friendly infrastructure. This is necessary at a time when global climate concerns are escalating. This has been incorporated through the MoHUA's Climate Smart Cities Assessment Framework 2.0 and 'Streets for People Plan', that puts pedestrians and non-motorised road users at the centre of urban planning.

Can you share some details on the Thiruvananthapuram smart anganwadis project?

In February 2021, the Department of Women and Child Development of the government of Kerala commissioned 48 "Smart Anganwadi Project". Conventional Anganwadis are being transformed into smart structures. These facilities are to be installed with better amenities to provide more child-friendly spaces for both the mental and physical development of children.

One of the key measures being undertaken by the government is to provide these anganwadis with the resources to help bridge the digital divide, and empower anganwadi workers.

Under the Nurturing Neighbourhoods Challenge that was conducted over three years, Bengaluru, Kochi, Vadodara, and Warangal made the winners list for their work on refurbishing anganwadi infrastructure in their states. More recently, the Jammu Smart City Limited (JSCL) also announced its initiative to convert 14 conventional buildings in Jammu into 'Smart Anganwadi Centres'.

This has been bolstered by the provision of the Union Budget that was announced on 1st February, 2022, which announced plans for two lakh anganwadis to be upgraded.

Cities are working towards data-driven governance. About 70 of them have established Integrated Command and Control Centres (ICCC) which facilitates decision-making. What are your insights on this?

NEC has implemented Integrated Command and Control Centres in the cities of Thiruvananthapuram (Kerala), Saharanpur (Uttar Pradesh), Kalyan Dombivli and Hubbali Dharwad.

Further, as part of our efforts to help the authorities' fight against the spread of Covid-19, we helped the Gurugram Metropolitan Development Authority (GMDA) convert its smart city control centre into a COVID war room.

This ICCC was set up to keep vigil on human and vehicular movements during the lockdown, especially inside the red zone. In some selected areas, NEC has deployed a special analytics function on selected cameras for crowd control to ensure appropriate social distance measures to mitigate community transmission.

Overall an ICCC helps bring various departments together to work as a single unit. Be it traffic management, traffic control, traffic law enforcement, security and safety, e-governance, municipal operations, or information dissemination, it serves as a decision support engine for city administrations.

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Smart Cities: Red Dots on the Blueprint

The Smart City mission is not just ambitious and exciting – it's about-time for a country like India. But as we keep moving forward, we need to keep acknowledging, and addressing, some blind spots and potholes on this path

BY PRATIMA H

The future of the Smart Cities Mission in India will depend on very detailed planning and flawless execution.

Design and Execution

Are the Indian Smart Cities coming together well?

There are challenges that keep emerging with smart city projects across the globe.

Consider what Steve Wray, Sr. Vice President and Principal, ESI EConsult Solutions Inc. says. "Our research of smart city strategies around the world has revealed the most advanced smart cities all progress through 4 key steps.

They leverage the latest technology, make data a strategic asset, work closely with partners outside of government and engage their citizens and employees.

Ankur Bisen Management Consultant & Author of 'Wasted- The Messy Story of Sanitation in India, A Manifesto for Change' raises the issue around waste management – critical component. "It's a long haul. I will not say that progress has not been made, butI would add that it has been patchy." There are positive outcomes in the

> "It's a long haul. I will not say that progress has not been made, but I would add that it has been patchy. It has been in pockets," says Ankur Bisen Management Consultant & Author of 'Wasted- The Messy Story of Sanitation in India, A Manifesto for Change'

> Communication with citizens has become fundamental to providing lifesaving information, and cities with strong data analysis tools have been better prepared to map and track outbreaks.

What Advanced Smart Cities do for Progress?

- They leverage the latest technology, both foundational (such as cloud, mobile, IOT and RTA) and more specialized solutions (such as biometrics, blockchain, AI and telematics).
- They make data a strategic asset, drawing on diverse sets of data from a variety of sources and using data analytics to put it work for the benefit of the government and citizens.
- The Open Data Framework in India is a step in this direction
- They work closely with partners outside of government to access specialized expertise, tools, and experiences. These partnerships can include academic institutions, private companies, financial institutions, industry associations, city networks and neighborhood organizations.
- They engage their citizens and government employees to both understand their needs and to receive feedback on applications of technology in the community.

Source:ESI EConsult Solutions Inc.

Key Challenges

1. Lack of vision
2. Execution delays
3. Fragmented approach
4. Technology for the sake of technology
5. Lack ofstakeholder and actual citizen involvementis a step in this direction

areas of plastic waste, tyre waste, e-waste management, solid waste management tools and policies.

Bisenfeels Indore has shown good evolution and best practices.

People

Housing and Land Rights Network (HLRN) highlighted in a report – "the critical question is whether the country should first focus on creating 100 high-tech urban enclaves or on prioritizing—for every resident—the provision of sufficient and potable water; adequate sanitation services; the highest attainable standard of health; adequate and secure housing; a clean and healthy environment; safe spaces to play, walk, and work in; accessible public transport; and security for women, minorities, and children?

Huge challenges that cities are facing

- **Healthy Communities:** The COVID-19 pandemic drew attention to safety in the face of a crippling epidemic.
- Communication with citizens has become fundamental to providing lifesaving information.
- Cities with strong data analytic tools and capabilities have been better prepared to map and track outbreaks. The use of technology in providing health care, through telemedicine, has allowed health care to be provided safely and efficiently through an internet connection.
- **Sustainability and Resilience:** While the impacts of climate change and extreme weather events predate the pandemic, cities and their citizens are experiencing the impacts on what seems to be an increasingly regular basis. Cities and communities are being asked to address challenges at an increasing pace.

Source:ESI EConsult Solutions Inc.

Implementation of the Smart Cities Mission should be linked with the Sustainable Development Agenda and its goals.

Sustainable Development Goal 11 ("Make cities and human settlements inclusive, safe, resilient and sustainable") is most directly related to the Mission, other goals and targets related to hunger, poverty, inequality, health, gender equality, land, water, and climate change must be integrated into the framework.

Priorities of the selected cities and their proposals should align with India's commitments under the Paris Agreement and its Intended Nationally Determined Contribution (INDC) towards climate change mitigation and adaptation.

Source: Recommendation by HLRN, Smart Cities Report, 2017

There is, thus, a need to evaluate the validity of the Smart Cities Mission as well as the model of development that it envisages."

"A more balanced urban-rural development approach would have led to greater equity and social justice. This would also be more in line with the Sustainable Development Agenda 2030."

Technology

The ability to embrace technology in a seamless and data-friendly way is key.

As the HLRN report mentions – "an overreliance on 'smart systems' to run critical infrastructure or centralized electronic grids, could result in serious problems when such systems crash. The consolidated electronic databases of information could give rise to privacy and security concerns, including identity theft and increased surveillance by the state and other agencies."

India is not the first country to confront skepticism and backlash about smart cities. Similar experiences and local resistance have pervaded smart-city programs in Toronto (specially the Sidewalk Labs Project), New York, Ross, California. Most of these fears emerged around use of technology like facial recognition.

When it comes to technology, there cannot be a 'One Size Fits All Model' argues Dr. Bhatt"technology can only supplement governance, it cannot be a substitute."

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Solid Waste Management – 5G and IOT can change the SWM landscape for India

Some Indian cities (Jhansi, Lucknow, Varanasi, South Delhi, Noida, Hubli Dharwad etc.) have already implemented IoT waste management solutions. Municipal corporations can closely monitor a city's entire waste management process

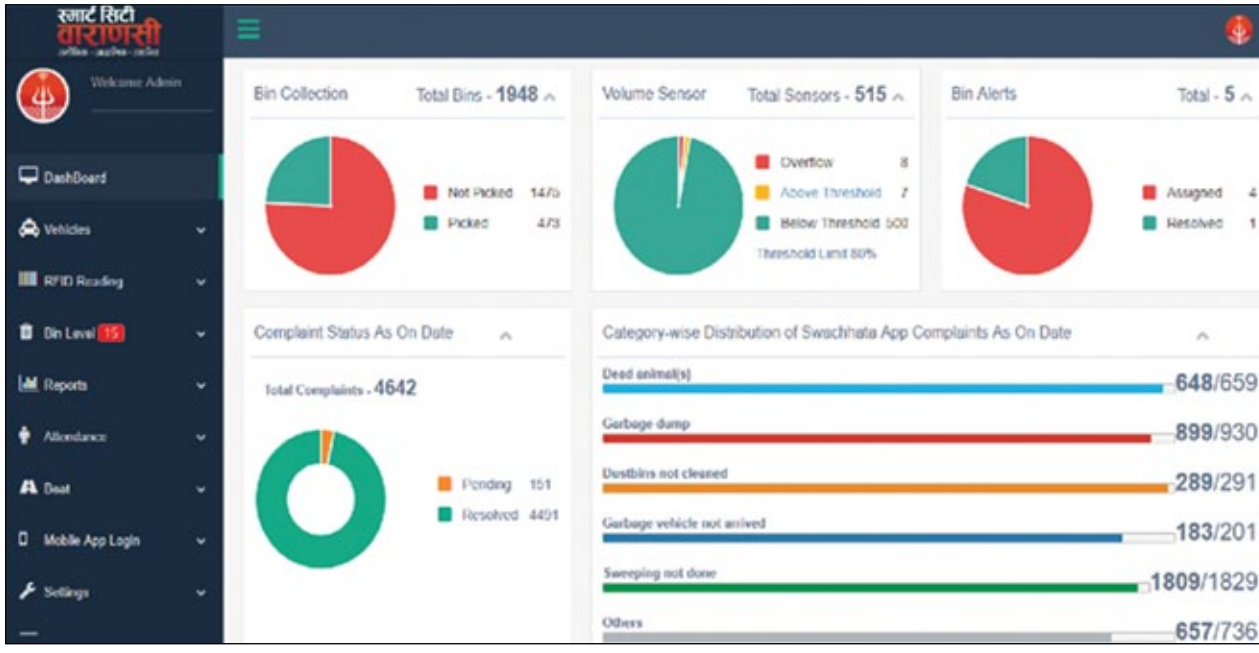
BY DEEPA JOSHI

India, the seventh-largest country in the world, generates 1.43 lakh tonnes of solid waste per day, of which only 24% is processed.While the Government of India's Swachh Bharat Mission propelled us to maintain cleanliness and manage waste efficiently, the path to success is still hazy.

Mismanagement of Waste is a primary reason behind clogged drainage systems and flooding.

The level of waste the country generates cannot be easily managed with archaic and outdated methods. Some Indian cities (Jhansi, Lucknow, Varanasi,

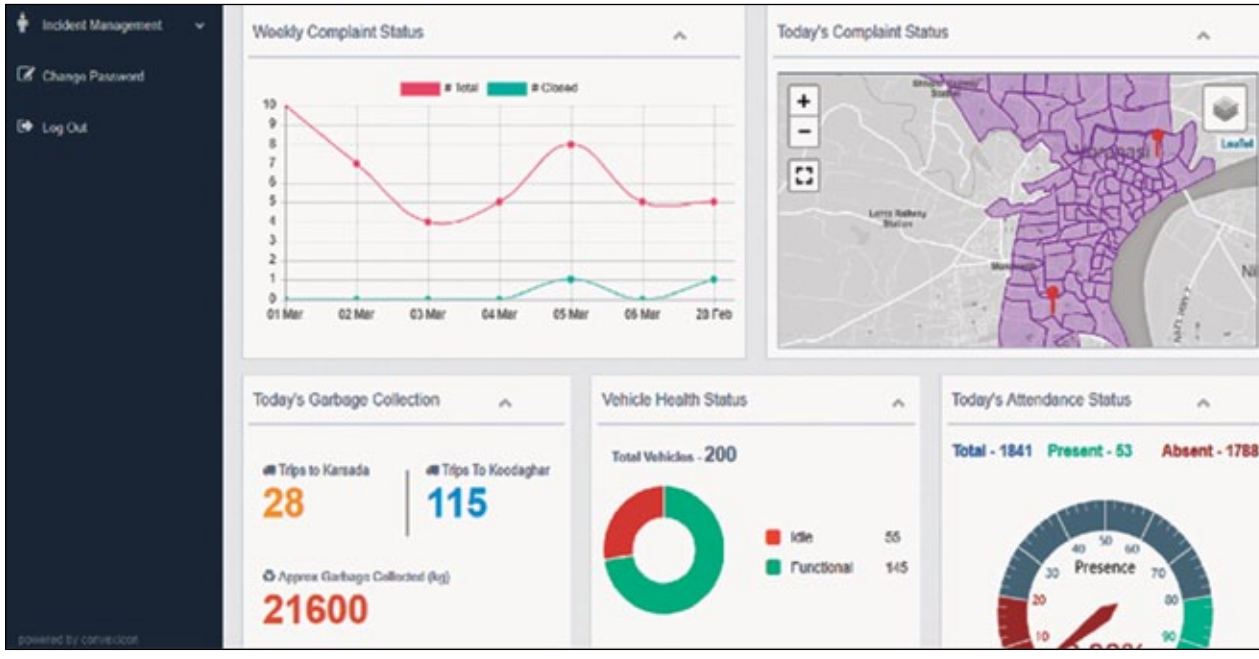
DASHBOARD – Monitoring inside a city (Varanasi)



South Delhi, Noida, Hubli Dharwad etc.) have already implemented IoT waste management solutions. Municipal corporations can closely monitor a city's entire waste management process.

The Internet of Things (IoT) is a network of physical objects embedded with software, sensors, and other technologies, allowing them to connect and exchange data with other devices and systems over the internet.

Incident Management System



These devices range from run-of-the-mill household items to avant-garde industrial tools.

IoT makes communication between people, processes, and things seamless.

Route Optimization

The automated route optimization of garbage pickup vehicles is one of the most common and most effective IoT applications in waste management operations. Indian cities that have already implemented solid waste management systems are saving time and money. Garbage collectors can avoid half-filled bins. They're routed directly to the sites with full trash bins.

No two disposal units can have the same load each day; it varies by day, week, and season. IoT waste management apps provide sanitation workers with insights into the actual fill level of various disposal units.

Waste collectors get an automated route planned for them that prioritizes areas in urgent need of cleanup and avoids disposal units that still have room, thanks to a user interface that reveals all bins' locations and fill levels. This results in a more efficient pickup process that does not take into account empty trash bins, saving fuel, time, and staffing costs.

Eliminates Issue of Trash Bin Over Flow

Overflowing bins, not only emit a toxic stench but also cause severe pollution and respiratory issues.

Information gathered by "smart" bins can send alerts if the sensors detect a bin is full. This, in turn, increases waste management efficiency and reduces trash bin overflow.

Waste Categorization

Categorizing waste manually is the most taxing and difficult task.

"SMART WASTE BINS" or "Digital Bins" are smart enough to recognize and categorize waste. These bins can sort waste into four categories: glass, paper, plastic, and metal.

In addition, these bins compress waste and notify sanitation workers when each waste category is full. So,

How Can IoT Help In Waste Management?

The automated route optimization of garbage pickup vehicles is one of the most common and most effective IoT applications in waste management operations. Indian cities are saving time and money using this application.

cities that have already implemented IoT-based solutions have happy sanitation workers and benefit from efficient waste management.

Data Analysis

In today's business environment, data plays a crucial role. Most importantly, how soon you're able to gather the data matters!The IoT-based waste collection monitoring systems allow authorities to have real-time data to take the right measures.

Connected devices not only monitor how quickly the bins fill up, but they also monitor how frequently the bins in various locations are emptied. This allows authorities to track the status of bins throughout the city in real-time. They can immediately plug the gaps and act as they arise with this information.

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The Great Humbling of Urban Tech

So that is why the voice and data industry needs to continue to address urban systems: for that is where they will be challenged to deliver the best, that is where they can push innovation that matters, that's where they will have opportunities

BY VINEETA SHETTY

A Decade

What a difference a decade makes. Before 2010, technology and city management were worlds apart. A decade later, the tech majors have hopscotched on to the next game, be that robotics or artificial intelligence, leaving a few expensive toys in the hands of city managers. One deputy mayor likened her new integrated command and control centre to a Television Showroom with banks of screens.

But many see this as good for the evolution of cities. Technology has left a permanent footprint in city managers' understanding of spatial and real-time data. Cameras may fall off their perch and wires get cut, but urban tech is here to stay. The concept of what makes a city smart or liveable is constantly evolving as it has for thousands of years.

The terms of discourse on Smart Cities may have been set by Cisco, IBM and SAP. But now they are reduced to selling components to the mid-level entrepreneur: their inheritors are the metropolitan-level systems integrators, who are often the ones to bid for the tenders for installing rubbish bins and GPS-tracked waste collection trucks. And they do a good job.

IOT manager / Waste Manager

For a while it seemed that an IoT solution architect was a better manager of waste than an assistant municipal commissioner. But the tech industry has been humbled into recognising that they are only one piece of the puzzle. Crores of taxpayer money have been spent on solid waste and sewage management infrastructure. But still cities are not cleaner: that's because waste management is a more complex problem. It is not just ensuring collection trucks are doing the beat or controlling them in real-time. There is behavioural change, asset adequacy, asset management, urban street structures, waste composition, density, form, resource availability to be considered and invested in.

Doing business with government was never easy, because of regulations and the maze of public procurement processes. Yet, very few voice and data network and service providers can afford to ignore urban administrations as important clients, as key as mining, gaming, and other enterprise segments.

Shrinivas Kowligi, who spent decades interfacing with the public sector at Price Waterhouse Coopers and later Ernst and Young, quotes the immortal lines of film villain Ajit to describe doing business with government: "Liquid isko jeene nahin dega, oxygen isko marne nahi dega." Vendors may keep cribbing that government is a cost leader, he says, but nobody will stop transacting with government because it is too big a segment and brings relevance and purpose to a lot of companies. Even if government is 5% of their business, that's the bit they will talk about to the outside world as driving change, helping society and countries.

So that is why the voice and data industry needs to continue to address urban systems: for that is where they will be challenged to deliver the best, that is where they can push innovation that matters, that's where they will have opportunities if they are successful in doing big business.

Urban challenges are more than just the technology, data and analytics challenge. There are people, demography, public policy, investment, politics: a whole range of issues that impact cities. So now, the buzz words are visual appeal, resilience, sustainability, climate-readiness, placemaking and public spaces. Techies, like journalists, have to understand this and keep step.

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Template for Smart cities to achieve ESG goals

Building- automation systems, dynamic electricity pricing, and mobility applications — can cut emissions by 10 to 15%

BY KS RAO

Half of world population, ~3.5 billion people, live in urban setup today and by 2050, >70% of the world population is predicted to live in urban settlements. But is our present infrastructure resilient enough to respond to the demands of such an exorbitant population surge?

Rapid urbanization is exerting immense pressure on our environment - freshwater supplies, sewage, and public health. Global cities occupy just 3% of Earth but account for ~75% of energy consumption and carbon emissions.

Cities are becoming more sustainable

The majority of cities worldwide have now recognised the importance of achieving environmental sustainability. Across the globe, nations and cities with robust and reliable digital networks have been able to establish technology ecosystems to mitigate environmental concerns:

- London is advancing towards sustainability through efficient waste management, air quality monitoring, pollution mitigation measures, and noise reduction policies.
- Electric buses are increasingly being used for public transportation in Seoul. It is also concentrating on expanding green spaces.
- Dubai uses solar energy to generate a major portion of its electricity. It uses separate drainages for grey and black water, allowing for better wastewater management. The city is also heavily investing in developing infrastructure for electric vehicles.

Indian cities can draw lessons from these cities to achieve sustainability goals. Smart city infrastructure can enable efficient ways to tackle air pollution, waste management and energy efficiency in Indian cities.

> Smart City is the one of the most critical steps towards providing a digitally empowered, sustainable infrastructure to all citizens and households at urban level and deserves top most priority.

India, needs to invest more in strong connectivity infrastructure and an open-source application ecosystem. Cities must push for efficient resource usage, from installing sensors to identifying leakage to employing behavioural economics to make informed resource decisions.

Leveraging digital technology

A robust infrastructure comprising connectivity, smart technologies and applications -- such as building-automation systems, dynamic electricity pricing, and mobility applications -- can cut emissions by 10 to 15%. Sensors with analytics can cut water losses by up to 25%.

Digital technologies like IoT and Big Data can be leveraged to disrupt and redefine sustainable living:

- **Smart Grid -** To ensure a reliable power supply, virtual power plants and enabling renewable energy resources, such as solar panels, can be connected to a network. On the smart grid, these plants use software-driven technology
- **Smart traffic management -** Emissions from vehicles lead to high concentrations of air pollutants and the negative health impact is huge. Using intelligent software solutions for transport logistics, traffic planning and traffic management can enhance road safety and minimise the impact on the environment
- Waste Management using smart waste bins
- Sewage treatment for converting treated sewage in form of water
- Water conservation by recharging the water table through rainwater harvesting

Approach for a successful smart city model

The key focus of Smart cities is connecting infrastructure to gather better insights and improve services and quality of life.

We recommend taking the following approach while designing and developing a smart city model:

Taking this holistic approach will help cities achieve a smart transformation.

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CTO - Access Solutions, STL

"Open RAN is a win-win for both- Telcos and Vendors"

Is there a need or relevance for initiatives like Open RAN- especially with 3GPP and GSMA already around? Why would it not be just another close-knit huddle of like-minded industry players?

Open RAN is quite relevant and has its own importance. It is a collaboration of Telcos and equipment vendors with an objective to define the standards and methodology which were left undefined in the 3GPP domain. 3GPP has defined the separation of control and user plane along with higher layer split over F1 interface. Open RAN brings true innovation by opening the front-haul interface over the lower layer split and making it standardized so that any vendor can develop accordingly and interconnect with any other vendor's O-DU or O-RU.

Open RAN enables flexibility and interoperability with complete openness to multi-vendor deployments. It defines open interfaces on baseband software-defined functions enabled on general-purpose hardware platforms.

Can we ever achieve true and on-ground/last-mile interoperability? What can be done to get there?

Certainly, we can achieve the last-mile interoperability. Since every telco and vendor understands the importance and benefit of being 'Open', all have put their best foot forward in achieving this in reality. Organizations involved in various forums such as Open RAN Alliance, TIP, ONAP, etc. are continuously engaged to define the next phase/specification of Open front-haul interface and at the back-end, they are developing their systems (Hardware as well Software) to support the full interoperability.

Conducting the interoperability testing and delivering a telco-grade matured product is not so easy and that's why organizations are toiling to test a product first in

> It is backward-compatible as well as future-proof. And while challenges like test labs, interoperability-proof, accreditation and ecosystem-work still envelope its path, Open RAN is moving in the right direction.

> Conducting the interoperability testing and delivering a telco-grade matured product is not so easy and that's why organizations are toiling to test a product first in their own environment (with simulators etc.) and then with real products from other vendors.

their own environment (with simulators etc.) and then with real products from other vendors. That is where the role of various communities and interoperability test labs becomes vital. Collaborations and events such as "Plug-fest" provide a platform for various vendors for showcasing their skills and strength.

How can these tenets of standardization and interoperability be balanced with competitive innovation and patents that industry players are investing in?

For any technology to become successful, standardization plays a pivotal role. Mass adoption requires mass production and mass production requires mass acceptance. In the past, we have seen many technologies which were good but couldn't deliver due to the challenges posed by the ecosystem.

Open RAN, as a technology, is being accepted across the industry. Telcos across the globe are showing their interest in trials and roll-out of Open RAN-compliant systems. Equipment vendors have shifted their focus from the development of traditional telecom units to the Open RAN compliant telecom units. With Open RAN as a truly innovative path for radio deployments, every other vendor wants to maintain the competitive edge by showing them as early adopters and innovators in this domain.

What challenges or gaps does the industry suffer – in your observation/opinion?

There are few challenges being observed by the latest stream of innovators. First is the cost associated with the development of the overall ecosystem and second is the unavailability of interoperability test labs.

Since Open RAN is the latest entrant in the technology domain, it not only needs to be backward compatible with the existing technologies but needs to investigate the future as well. In other terms, it requires to be working for the existing generation of mobile communication i.e., LTE and it must work for 5G NR as well. Development cost and collaboration efforts become greater when you need support from other innovators in terms of readiness of their system to prove the interoperability.

Furthermore, the availability of an authority who can certify the functionality of two different products for the Open RAN compliance plays a very important part. Once accreditation from the local authority is available, support from other industry verticals can be sought for the overall development of the ecosystem.

What are the implications of 5G, Edge Computing, private LTE, DIY networks, Blockchain-based systems, and Industry 4.0 – if any – for Open RAN?

It may have been the case previously that with the advent of new technology, its predecessors and contemporary technologies got affected or vice-versa. In the case of Open RAN, this does not hold true. In fact, today in the technology world, where everyone speaks for Openness, Agility, Flexibility, and Security, Open RAN has it all.

Open RAN has all the benefits of 5G. It is flexible to support various deployment scenarios. It is technically efficient to support a variety of use-cases/applications delivering high data rates, millisecond latency, and billions of connections. Since it inherently supports segregation of control and user plane traffic, it complements edge computing. It is rather much beneficial to deploy a private network (LTE or 5G) with Open RAN because it can help you save cost and bring in more efficiency with customized features supporting the specific applications in the private network, which would otherwise be costlier and time-consuming considering the overall development and deployment. In a nutshell, Open RAN doesn't get affected by any of the technologies or scenarios. Rather, it provides a win-win scenario for both, the telcos, and the vendor organizations. It provides the opportunity to the telcos to be a part of the innovation and development cycle and gives freedom to choose its own set of network builders in a cost- & time-effective way.

Crypto Currencies - Asset Class or Legal Tender?

The basic mistake that central banks and governments are making is to equate crypto currency with legal tender. Crypto currencies – despite their name – are not currencies

BY PROSENJIT DATTA

The Union Budget introduced the crypto currency tax. The Finance Minister announced that 30% tax would be applied on income from transfer of digital assets – which presumably means crypto currencies, non-fungible tokens (NFTs) and any other such digital token based products). If they were given as gifts, it would be taxed in the hands of the recipients. And no set off against losses would be allowed.

Later in the evening, senior Finance Ministry bureaucrats clarified that this did not bestow legitimacy to cryptos. India is one of the few countries which empower the tax man to collect dues from both legal and illegal activities. The government will decide later on whether crypto currencies should be made legal. Its current uncertain legal status does not prevent it from being taxed.

The government's hesitancy in bestowing legal status to cryptos probably stems from the staunch opposition of the central bank. The Reserve Bank of India (RBI) wanted crypto assets banned. It had issued a circular to that effect in 2018 but the Supreme Court ruled against the ban.

Central Banks globally see cryptos as a threat to their authority of issuing and managing the legal tender in their countries. A peer-to-peer global exchange system that bypasses their regulatory authority is obviously not something they can support. Some central banks are trying to bring out their own alternatives. China already as an official digital currency and in her speech, the Finance Minister announced that India too planned to have one.

However, the basic mistake that central banks and governments are making is to equate crypto currency with legal tender. Crypto currencies – despite their name – are not currencies. They do not have any underlying value – being untethered to any physical asset and not guaranteed by anyone official. They only follow the basic rule of supply and demand, with the mining process determining the supply.

Only Bitcoin, the original crypto currency has been conferred with the status of a legal tender by one country,

El Salvador. It doesn't have its own currency. It used the US dollar as its legal tender and now as also accorded the same status to Bitcoin. It is currently facing a fairly rough ride because of the volatility in the crypto market.

Many economists think that cryptos are a bubble and they could well be. With no physical asset underpinning them, their value derives from supply, demand and what buyers are willing to pay. But they are here to stay for the foreseeable future.

Many countries treat cryptos as an asset class, not legal tender. If the Indian government is taxing crypto income, it makes ample sense to do the same. And build a regulatory mechanism for them – on the lines of the SEBI perhaps but only focused on digital assets and with properly licensed and regulated trading platforms. The approach will allow only the most established cryptos and other digital assets to be traded, on the basis of clear and transparent rules, and keep track of them. This will bring some law to what is essentially a wild west at the moment.

Prosenjit Datta was the Editor of Business Today and is currently with Ernst & Young as Advisor Analytics and Content

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BHARAT B. BHATIA

Evolving Mobile Communications from 5G to 6G (Part 2)

Even while we roll out 5G networks, plans to move to the 6G vision is underway. Expected to be a reality by 2030, globally 6G will be powering the "Internet of Senses". A fusion of the physical, digital, and non-physical worlds; in effect moving user engagement away from mobile phones and into a multi-sensory experience

Continuing our series on 6G from the last issue

Technologies for 6G

6G mobile communications technology will build on many enabling wireless technologies that are already established for 5G. Some of these existing new technologies that will be further developed for 6G are

- **Millimetre-Wave technologies:** Using frequencies much higher in the frequency spectrum opens up more spectrum and also provides the possibility of having much wide channel bandwidth. With huge data speeds and bandwidths required for 6G, the millimetre wave technologies will be further developed, possibly extending into the Terahertz region of the spectrum.

- **Massive MIMO:** Although MIMO is being used in many applications from LTE to Wi-Fi, etc, the numbers of antennas is fairly limited -. Using microwave frequencies opens up the possibility of using many tens of antennas on a single equipment becomes a real possibility because of the antenna sizes and spacings in terms of a wavelength.

- **Dense networks** Reducing the size of cells provides a much more overall effective use of the available spectrum. Techniques to ensure that small cells in the macro-network and deployed as femtocells can operate satisfactorily are required.

In addition, 6G will see many new technological and applications innovations. Some candidates new technologies and applications, that are being talked about could include the following:

- **Terahertz communications:** Using these exceedingly high frequencies, huge bandwidths will become available, although the technology is not available to make this happen.

- **Synaesthesia Interconnection:** Synaesthesia Interconnection is the joint communication of the multiple senses (haptic, taste, smell, etc.). The absolute latency to support real-time feedback is very challenging and the relative synchronization among the multiple senses would also need to be maintained to make it real.

- **Immersive Cloud XR:** X-Reality, such as virtual reality (VR), augmented reality (AR), and mixed reality (MR) is expected to provide higher resolution using immersive cloud

- **Holographic Communications:** Holographic communication provides real-time three-dimensional representation of people, things, and their surroundings into a remote scenario. It requires at

> 6G mobile communications technology will build on many enabling wireless technologies that are already established for 5G.

> With China investing large amounts into technology, they are keen to gain a lead in 6G.

least an order of magnitude high transmission rate and powerful 3D display capability.

- **Digital Twin:** Digital twin is a digital replica of entities in physical world, which demands real time and high accuracy sensing to ensure the accuracy, and low latency and high data transmission rate to guarantee the real time interaction between virtual and physical worlds.

- **Intelligent Interaction:** Intelligent agents with perception and thinking capability will produce active intelligent interactive behaviours and realize emotional judgment and feedback intelligence at the same time, which needs extremely high reliability.

- **Multidimensional sensing:** Sensing based on measuring and analysing wireless signals will open opportunities for high-precision positioning, ultra-high resolution imaging, mapping and environment reconstruction, gesture and motion recognition, which will demand high sensing resolution, accuracy, and detection rate.

- **6G Global developments:** There are already a number of 6G technology projects that are under way at the moment, and some organisations are now starting early development.

- **South Korea Electronics and Telecommunications Research Institute:** As might be expected, South Korea is well ahead and this institute is conducting research on Terahertz band technology for 6G. They are hoping to make 6G 100 times faster than 4G LTE and 5 times faster than 5G networks.

- **The Ministry of Industry and Information Technology, MIIT, China:** With China investing large amounts into technology, they are keen to gain a lead in 6G. Accordingly, MIIT is directly investing and monitoring the research and development process of 6G in China.

- **The University of Oulu, Finland:** This university has started a 6G research initiative known as 6Genesis. The project is expected to run for at least eight years and it will develop ideas that will be suitable for 6G technology almost to 2040.

- **US Next G Alliance:** United States was lagging behind the most advanced countries in the 5G research and development. In October 2020, US industry association, Alliance for Telecommunications Industry Solutions (ATIS) launched the Next G Alliance, an initiative aiming to lay out the foundations of 6G in North America. This group currently has 43 founders and contributing members, including some tech giants like Google, Apple, Microsoft, Facebook, and most of the major carriers in the U.S. and Canada. Unlike other programs that foster 6G, the Next G Alliance was born from a market initiative, not from governments' efforts to set up a policy or vision. Besides funding and research, the Next G Alliance will look at manufacturing developments and standards from a high-level strategic perspective. The idea is to engage the international community in discussions about standards and how government and industry can work together.

- **The European 6G flagship program Hexa-X:** Funded by €11.9 million from the European Union's Horizon 2020 program, Hexa-X is a two-and-a-half-year program coordinated by Nokia that comprises 25 members, like Ericsson, Intel, and Orange. The consortium 6G vision comprises a network capable of connecting the physical, digital, and human (senses, bodies, intelligence, and values) worlds.

- **EU Projects RISE-6G and NEW-6G:** In February 2021, two new 6G European initiatives were announced. RISE-6G, a European Union-funded consortium of 13 members across the continent launched under 5G-PPP, focused on Reconfigurable Intelligent Surfaces; and the NEW-6G, which stands for Nano Electronic and Wireless for 6G. RISE-6G will receive €6.49 million from the E.U. under the Horizon 2020 program and dive into a specific aspect of the next generation of mobile connectivity.

Bhatia is President, ITU-APT Foundation of India (IAFI) and Vice Chairman, Asia Pacific, World Wireless Research Forum(WWRF)
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Growth of Digital Healthcare in the era of Smart Cities

The future is going to be about the Internet of Health and each user will be generating 1 TB worth of health data every year. No human can possibly analyse or make sense of this data.

BY VISHAL GONDAL

We are at the cusp of a boom in Healthcare technology. The scope is broadening every day and so are the opportunities. Government policies like the National Digital Health Mission (NDHM), Guidelines for Telemedicine 2020 and E-pharmacy Rules have set the ball rolling for digital healthcare in India.

From heart rate monitors built into watches to glucose monitors integrated into contact lenses, the healthcare industry is heading into some interesting and revolutionary times. Just as in fintech where startups sprang up and eventually overhauled the system through digitisation, healthcare space will see a revolution.

Adopting technology with prevention, diagnosis and treatment will get us close to the goals of digital health. Technology has already led to paradigm shifts in healthcare from a 'sick-care' model to a preventive or wellness-based model.

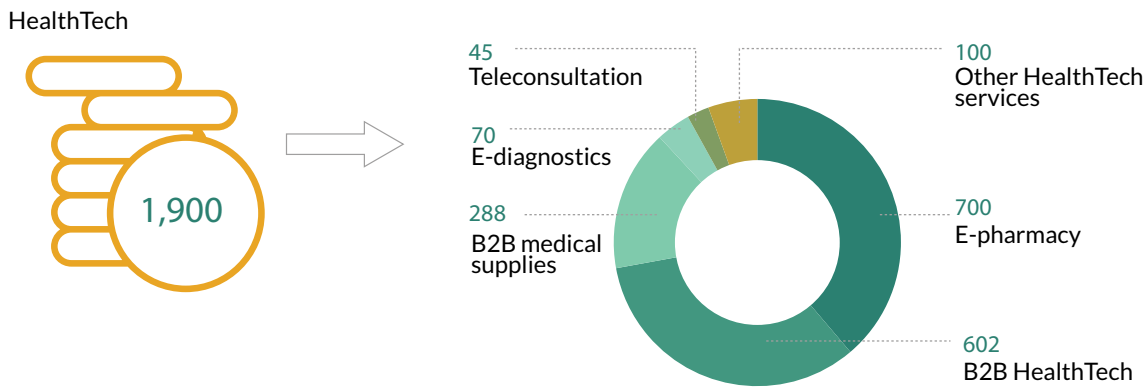
Let's take a quick look at the opportunities and challenges.

Opportunities:

- Digital health offers the ability to help individuals monitor and manage chronic illnesses while also preventing diseases and lowering healthcare expenses.

Indian HealthTech market size (2020)

HealthTech market (US$ M)



- E-pharmacy and B2B HealthTech are the two largest segments in the HealthTech sector and account for ~70% of the overall HealthTech market
- E-diagnostic and teleconsultation are the fastest-growing subsegments in HealthTech; growing at 66% and 73% respectively

Credit: HealthTech Predictions 2021: IAMAI-Praxis report

The technology has already led to paradigm shifts in the healthcare industry from a 'sick-care' model to a preventive or wellness-based model. In the long term preventive healthcare is the only viable, long term, mass market solution.

HealthTech

HealthTech is a fast-growing industry vertical within the broader healthcare sector. It currently accounts for only 1% of the sector at ~US$ 1.9B in 2020 growing at 39% CAGR and expected to reach ~US$ 5B by 2023. It comprises of all technology-enabled healthcare products and services that are delivered and/or consumed by the patients inside and outside of the hospital or physician's office like E-pharmacy, E-diagnostics, teleconsultation, B2B HealthTech, B2B medical supplies, and other healthcare solutions like personal health management, online home healthcare, etc.

Courtesy Praxis-IAMAI healthtech predictions 2021

- It personalises medicine for each patient.
- Doctors, nurses, therapists, or nutritionists, get immediate and dependable access to the patient's information.
- A digital health system tool such as Electronic Medical Records (EMRs) digitises patient information from various sources, helping doctors make an accurate prognosis in a shorter time.
- Telemedicine can reduce the time it takes to consult a doctor in both rural and urban areas by avoiding the need to travel.
- Wearables can enable healthcare consumers to analyze their biomarkers, receive digital coaching services and benefit on their insurance plans.
- Artificial intelligence (AI) is poised to become a transformational force in healthcare.
- With AI, large amounts of datasets can be analysed and patterns found at scale. Learning algorithms can become more precise and accurate as they interact with training data, allowing humans to gain unprecedented insights into diagnostics, care processes, treatment variability, and patient outcomes.
- The future is going to be about the Internet of Health and each user will be generating 1 TB worth of health data every year. No human can possibly analyse or make sense of this data. Only with AI can we use this to build personalised therapies.
- More accurate data flow, allows individuals to get better insurance covers. Insurers will be able to develop closer relationships.

Challenges:

- Affordability and Accessibility can be a concern. Services cannot be spread proportionately to distant locations. Without financial ability rural / remote access to healthcare is difficult.
- There is a need to incentivise adoption of digital health for public and private healthcare providers. In western countries telemedicine, hospital information system (HIS) and electronic medical records (EMRs) are adopted as part of an overall healthcare delivery system.
- There is a need for strong Data Privacy laws. Health data can be misused in the absence of a robust data protection law. Hence, a strong data security architecture needs to be built and put in place. Healthcare technology firms have to exercise significant care when collecting, processing and storing personal health data. While sharing health data may be the key for medical innovations, checks and balances with clear guidelines on accountability need to be created.

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Security in a VUCA world

Today digital security that is just based on fingerprinting of traditional signatures, without understanding the new Tactics, Techniques and Procedures (TTPs) is living in the dinosaur age

BY VENKAT KRISHNAPUR

The acronym VUCA was reportedly coined by the United States War Army in 2001 after the 9/11 attacks in the United States. VUCA is a highly charged Volatile, Uncertain, Complex and Ambiguous world environment that requires a different level of management and leadership. While this was largely reflective of the physical world, VUCA is now equally true and relevant in the Digital space.

With an explosive growth of digital needs and services particularly after the pandemic, the threat landscape has only exponentially increased – across both Consumers and Enterprises.

In the Telecommunications industry in particular, this could not have been truer. Given the high interconnectivity and data proliferation – driven by both the pandemic as well as the proliferation of IP enabled devices on the networks, the telecom sector, has become a fertile ground for attacks – both at the ISPs as well as at the end Consumer.

Compounding the risks are newer technologies such as 5G.

Vulnerabilities in Protocols

The risks come from potential vulnerabilities in the new protocols as well as the exponential increase in the number of active IP addresses on account of the proliferation of Interent of Things (or IOT) devices. The massive spurt in data to the cloud for analysis and action is not always done by applying the right data security practices such as encryption, anonymization and so on. This has serious consequences when consumed by

In the Telecommunications industry driven by high interconnectivity, data proliferation and large numbers of IP enabled devices on networks, the sector has become a fertile ground for attacks. Compounding the risks are newer technologies such as 5G.

malicious actors who are constantly trying to find holes across the entire eco-system – from the devices to the network to the cloud.

Additionally, as quantum computing gets more reliable and accurate, this has serious ramifications on the fundamental assumptions around techniques such as encryption itself– which is a cornerstone for securing most of the data today. The ability to crack the encryption of the data that is at rest or in motion will soon shift from nearly infinity to milliseconds in terms of time.

TTPs

Today digital security that is just based on fingerprinting of traditional signatures, without understanding the new Tactics, Techniques and Procedures (TTPs) is living in the dinosaur age. The threats have undergone a massive shift. When you consider the potential to exploit the vast number of devices in a network infrastructure and the sheer increase of humans in the process, along with enabling technologies such as AI/ML, 5G, quantum computing and so on - traditional approaches to Digital Security only will no longer be reliable.

Digital Security must rapidly evolve to meeting these threats.

Here are some of the considerations:

- As attacks on an increasingly driven SD-WAN environment go up – it has implications on the need for the appropriate Cloud security for Enterprises and businesses. A SASE based approach would be required that secures both data and the IAAS, PAAS and SAAS environments.

- Digital Security would need to OPEN architectures that allow for data AND the analytics to be shared across different internal and external environments.

- Analytics goes beyond the end point. The data would need to be processed intelligently and appropriate Security actions taken in real time through an Extended Detection and Response mechanism. (XDR)

- Pro-active Security that uses intelligence gathered from different sources and insights would need to be applied in the context of the current Enterprise or Consumer infrastructure.

- A Zero Trust approach would need to be diligently applied to all traffic – both internal and external and across the entire environment.

- The Human threats – both internal and external need to be assumed by default into the Security posture. This includes training and monitoring for Insider threats as well.

- Interconnected systems that are constantly sharing information in a highly reliable automated process would be needed. No longer are SOCs in a position to handle the millions of threats per day manually.

- AI and ML systems need to be built such that they account for adversarial learning and manipulation.

- In the coming years, encryption techniques would need to factor in the enablement of new avenues for cybercriminals through the use quantum computing and develop counter and effective resistant techniques to stay ahead of the cybercriminals.

- Frameworks such as MITRE are constantly evolving, and it would be highly advisable to leverage to evolve a comprehensive set of policies and processes to minimize risk.

In short, this is where Living Security becomes the call to action - a security technology that learns and adapts to protect operations from a sophisticated array of threats. Constantly learning, constantly adapting, constantly evolving to provide the lattice platform or the trellis around which customers, corporates, society, and governments stay protected.

Venkat Krishnapur is Vice President of Engineering & Managing Director, Trellix
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Software Technology Parts of India (STPI) creating tomorrow's IT Leaders

For supporting the software product industry, Government of India has launched National Policy on Software Products (NPSP) 2019 with a vision to reach this industry to a $80 billion by 2025

BY ARVIND KUMAR

Indian Information Technology (IT) industry had witnessed a tremendous and disruptive growth over the last three decades due to the pivotal role played by Software Technology Parks of India (STPI) while discharging its services to flourish the IT/ITES Industry.

The Indian IT Industry achieved a landmark target of software services exports to the tune of $150 billion in FY 2021, of which STPI-registered units have contributed around 45%. This leadership in IT has differentiated itself from other industries by focusing and emphasizing on exports, employment generation and Foreign Direct Investment (FDI).

STPI is working with concerned stakeholders for maintaining the growth in software services exports

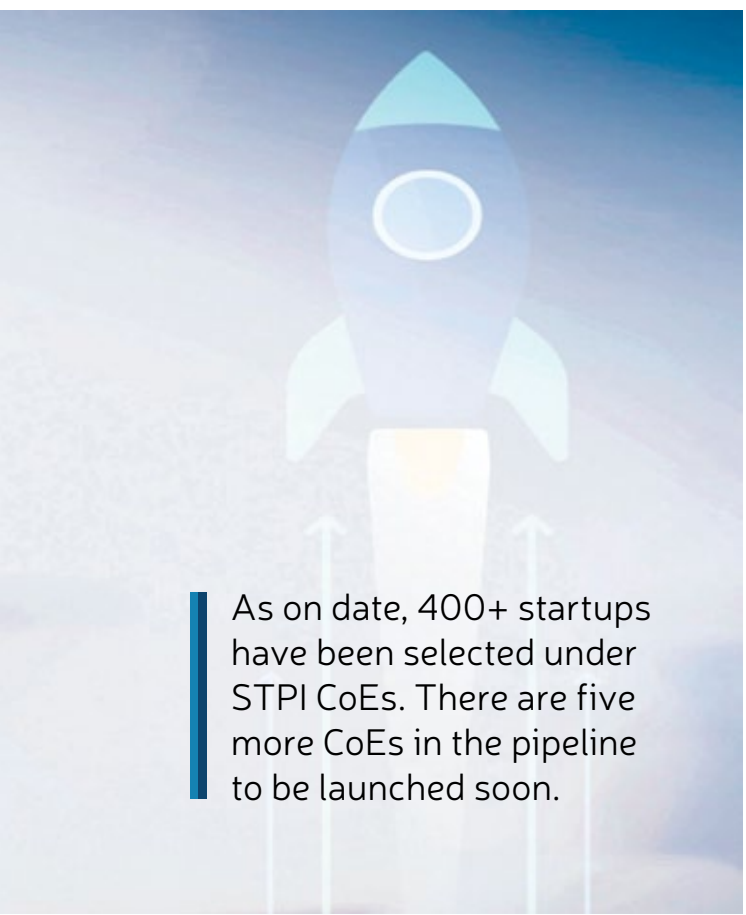
> STPI has launched 20 CoEs across India in emerging technologies and domains such as Artificial Intelligence, Internet of Things (IoT), Blockchain, Augmented Reality, FinTech, MedTech, Data Analytics, Agri IoT, Automotive, Electronics System Design and Manufacturing, Gaming & Animation.

year-on-year and dispersal of IT Industry to Tier II/III cities of the country for balanced regional growth. In addition to this, STPI is now leveraging the strong foundation of IT Industry and working to increase the share of the pie in the revenue of software products in the world which is presently around $9 billion. For supporting the software product industry, Government of India has launched National Policy on Software Products (NPSP) 2019 with a vision to reach this industry to a $80 billion by 2025 and to nurture the tech startup ecosystem in the country.

As envisioned in NPSP 2019, STPI evolved Centres of Entrepreneurship (CoEs) program in a collaborative manner with State Governments, Industry, Industry Associations, Academia, etc. with a vision to nurture 1,900+ startups by 2025 and to become one of the largest tech startup ecosystem enablers in the country.

STPI has launched 20 CoEs across India in emerging technologies and domains such as Artificial Intelligence, Internet of Things (IoT), Blockchain, Augmented Reality & Virtual Reality, FinTech, MedTech, Data Analytics, Agri IoT, Automotive, Electronics System Design and Manufacturing, Gaming & Animation, and Industry 4.0. These CoEs have enabled a strong startup support ecosystem comprising of 200+ mentors and approx.

150 partners for creating world-class, cost effective software products by the startups. As on date, 400+ startups have been selected under STPI CoEs. There are five more CoEs in the pipeline to be launched soon.



> As on date, 400+ startups have been selected under STPI CoEs. There are five more CoEs in the pipeline to be launched soon.

With a vision to nurture tech startup ecosystem further in Tier-II/III cities of the country, STPI has launched Next Generation Incubation Scheme (NGIS) from 12 locations of the country. 42 startups have been selected through Challenge Hunt Under NGIS for Advanced Uninhibited Technology Intervention (CHUNAUTI) 1.0 and 38 startups have been on-boarded.

Recently, 129 startups, mainly women-led startups, have also been selected through CHUNAUTI 2.0 program and the process of on-boarding is going on.

By leveraging strong footprints of 62 centres pan-India, STPI is committed to democratise the IT growth and success of Tier 1 cities in Tier-2/3 cities of the country which in turn, create significant employment opportunities and attract investment in those regions.

Arvind Kumar is the Director General of Software Technology Parks of India (STPI). He was earlier Advisor in TRAI since 2004.

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The role of ICANN in safeguarding the global, united Internet

ICANN's mission as a public interest organization is to preserve the security, stability, and resiliency of a single interoperable global Internet

BY SAMIRAN GUPTA

Every time you go online, regardless of what device you are using, what type of network you are connected to, or where you are in the world, you touch something that originates from ICANN. This is because, globally, the distribution of IP addresses and domain names originates with ICANN. ICANN is also responsible for the maintenance of identifiers related to many other protocols that enable the functioning of the Internet.

Today, nearly 5 billion people, more than half the world's population, use the Internet. Whenever they do, they are connected to the Internet's technical infrastructure – managed and taken of in some way or the other by ICANN, which provides key pillars of that infrastructure.

ICANN is part of an Internet ecosystem that works together for the global public interest. ICANN works closely with other technical partners in the ecosystem to help enforce and evolve the rules, developed some 40 years ago, that ensure we have one single secure, stable, interoperable Internet.

> Without the deliberate and joint decision to adopt a common domain namespace, a common IP addressing system and the same protocol specifications, the success story of the global Internet could not have been written.

> The Internet is too important for any one or a few actors to determine how we deal with these issues - whether it is a government or a business.

As we look to future-proof the Internet, we need to remember an important lesson from the past: The biggest factor in enabling the growth and success of what we today call the global Internet was the ability to reach consensus decisions on key standards. Without the deliberate and joint decision to use a common domain namespace, a common IP addressing system, and adherence to the same protocol specifications, the success story of the global Internet could not have been written.

This is because the technical aspects of the Internet are governed through the ICANN multistakeholder model (MSM); one of the most inclusive and democratic forms of decision-making. Through this model, individuals, non-commercial stakeholder groups, industry, and governments play important roles in consensus-driven, policy making.

Said differently: Technical Internet governance is focused on the way the Internet works; the purely technical aspect of Internet governance, relating to the components that contribute to a single interoperable secure, stable, and resilient Internet.

Increasingly, there are discussions among governments, businesses, and civil society that want to tackle the latest challenges in connecting more people to the Internet by creating new venues and new rules.

To be clear, cybersecurity, protection of personal data, data localisation, Internet access, and public safety are critical issues that must be addressed. But doing so requires a clear understanding of the technical underpinnings of the Internet. If that is missing, changes can negatively affect how the Internet operates and potentially result in accessibility problems for all Internet users.

The Internet is a critical resource, and it will continue to be. This was never truer than during the COVID pandemic. Without a single, interoperable, and secure Internet, millions of people would have been out of work, students would have missed a year or more of their education, and the global economy might have collapsed.

The Internet is now a global infrastructure. It is too important for any one or a few actors to determine how to deal with issues like governance, policy, regulations, technical standards or the business.

Thus, a multistakeholder-driven approach helps ensure that everyone's voice is heard and that changes to the technical governance of the Internet are made by consensus and with full participation of all stakeholders.

ICANN supports all efforts to strengthen the multistakeholder model of Internet governance because only when governments, citizens, businesses, academia and others work together can an equitable Internet for the next billion users be built.

Samiran Gupta is Head of Stakeholder Engagement for Internet Corporation for Assigned Names and Numbers (ICANN) South Asia

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What helps and what stops India with 5G?

5G should not be confined to some main cities. It must go deep into the country — Akhil Gupta, Vice Chairman Bharti

BY V&D BUREAU

In the TLF V&D Dialogue 5G Series on "Strengthening Digital Infrastructure & Technologies" various industry experts put the spotlight on some burning questions that we need to address like – digital inclusion, digital security, the contribution of digital economy to India's future, the Broadband infrastructure fund and many adjacent challenges.

Moderator Pradeep Gupta, Chairman, CyberMedia Group asked the panel about the demand landscape in the post-pandemic space as we move towards new 5G applications and a new world of use-cases.

Mobility itself is a big use-case in India and so is Broadband, pointed out Akhil Gupta: Vice Chairman, Bharti Enterprise. "We need a wireless solution and 5G is a good answer. Apart from robotic surgeries and driverless cars and other such applications seen in global areas, in India we can look at many dedicated and fully-encrypted industrial solutions."

"Up to 4G it was all about mobility, and now in the new world, the importance of network coverage, adequate spectrum etc. would become critical. The use would be towards a lot of areas- Where pricing, interoperability etc. would matter a lot. India may outpace others in the development of apps as industry 4.0 will take strong shape in India. Service-level apps would be strong areas here and we will emerge very well due to our inherent strengths." Argued Lt. Gen. Dr. S P Kochhar, Director General COAI

"5G offers an incredible promise for enterprises – specially in areas of faster speed with lower latency

> Connectivity and reach are important for the digital growth of India and for that we need wireless coverage where 5G becomes a natural choice. 5G should not be confined to some main cities. It must go deep into the country. Instead of spending money only spectrum, operators should also invest in networks.

and increased connectivity. It would a paradigm shift in operations of an enterprise. Customer experience and employee experience will also see positive impacts due to 5G. Also smart city applications would emerge as areas with huge promise." Augured Anjan Das, Chief Policy Advocacy Officer, STL – Sterlite Technologies Ltd.

The panel dwelt on the possibility of infrastructure sharing for 5G. There is no limitation of technology. Device prices - that is also not an impediment. But spectrum pricing will determine a lot of progress. 5G will need multiples of current infrastructure if we want to take it all over the country. We will need massive infrastructure – small cells, industry sharing, fibre etc. The number of base stations required in 5G are also higher compared to conventional technologies. We need regulatory mandates for more fiberisation, the requisite impetus at many levels and measures for strong fibre networks while removing duplication. Permissions for network roll-outs, Right of Way confusion, plausibility of PPP models with focus in the area of minimum quality standards, correct pricing, control on predatory pricing, differential rates for trenching, strong encouragement for research and development and patents, enforceable policies and other such challenges also have to be looked into.

The panel also averred that policy level issues, spectrum availability and industry collaboration would be key determinants of how India's growth story here moves ahead. The government has taken some measures to improve the policy part. We need strong execution path now – like uniformity, automatic escalations, reasonable pricing, infrastructure improvement, long-sighted initiatives and other practical issues. Even if fibre becomes easy to roll out, we will need to make sure it reaches well and uniformly with back-haul and access. The telecom industry has to be financially stable and profitable to move towards the future. The industry has gone through a lot and is still fragile in many aspects. For India to be a leader, we need to ensure that the industry in the country is financially-solid and robust.

"Connectivity and reach are important for the digital growth of India and for that we need wireless coverage where 5G becomes a natural choice. 5G should not be confined to some main cities. It must go deep into the country. Instead of spending money only spectrum, operators should also invest in networks." Reasoned Akhil Gupta: Vice Chairman, Bharti Enterprise

Will the same debate about funding and technology-readiness continue when we move to 6G too, the moderator spurred some good brain-storming on open architectures and sustainable models. How can we create something that is future-proof? The panellists suggested that networks need to evolve and there should be a concerted effort so that networks can adapt to any technology leap with a software change instead of a hardware change.

The panel also dismissed the idea that India was slow on 5G. Some level of technology maturity is essential. We are not late. We are evolving well. Specially as the security challenge is also immense now. Most networks are software-defined so all vulnerabilities of software accrue here. To control software we have AI so we have to be wary of corruption of AI. It is, hence, a complex area from a security angle. We need flexibility and adaptability to take care of security. So an overlay approach will not work. It has to happen organically. This is where India can emerge as a smart country. India can leverage on our innate software strengths well here. The panel also hinted that the country has already started working well in the direction of 6G – with concerted discussions and efforts among academia, government and industry on models, standards etc.

Key interventions that the panel recommended were these – priority to digital infrastructure in policy think-tanks, no compromise on quality and security aspects, creation of domestic champions, financial sustainability of the industry, light-touch regulations, focus on telecom as a utility, making Internet available for everyone and sharing of infrastructure.

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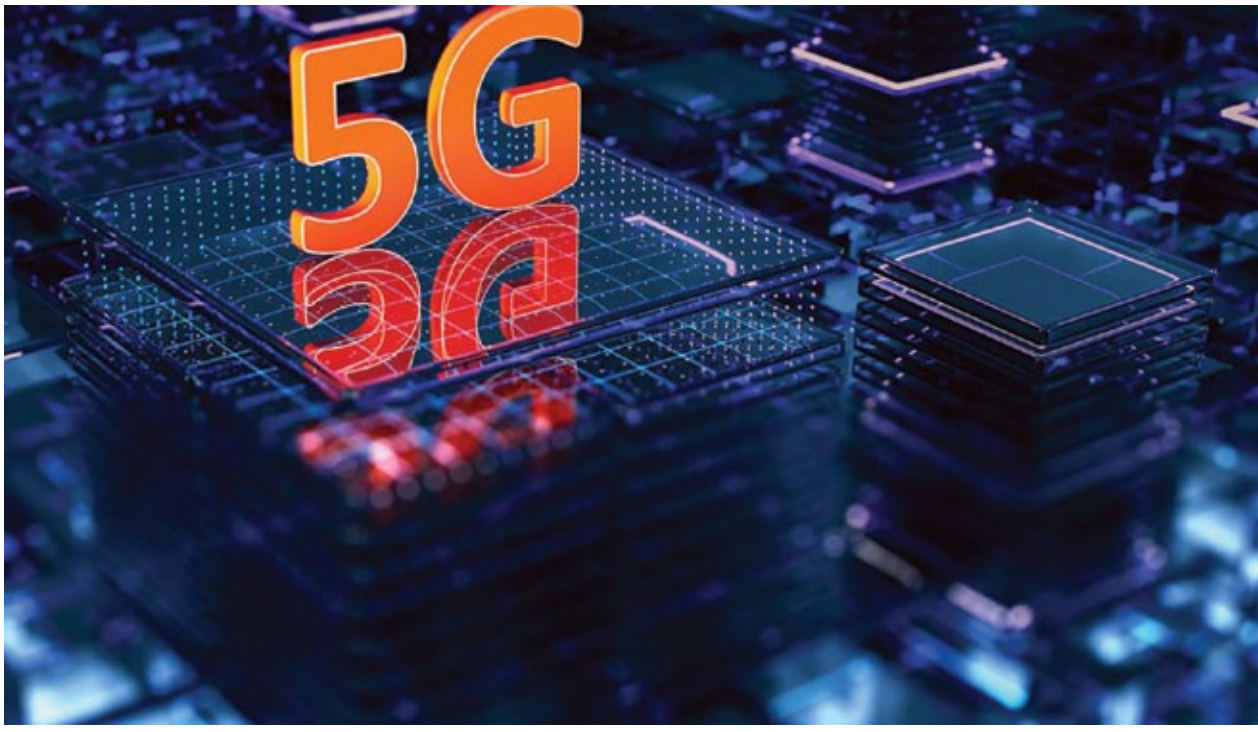
2022 Will Be the Year of 5G



BY HEMANT KASHYAP

No mobile standard has generated as much fanfare as 5G has managed to, and rightly so. Last year was all about talking up the next generation. However, this year it all comes down to actually rolling back sleeves and getting down with it.

Here's to 2022, the year defined by 5G.

The 5G Hype Train

The definition of 5G changes from person to person, and ranges from "a waste of time" to "the next best thing in telecom". However, like all the things in life, 5G falls somewhere in the middle. For all intents and purposes, it is the next step in telecommunications. And to be honest, almost no one that uses a phone has not heard of the next-gen networks. Almost every one of us has heard of 5G and has read, heard, or seen the word plastered all over the internet. India has it no different; 5G has captured the country's imagination like no other generation before.

One thing's for sure; the industry is enthusiastic about 5G and what it can do. Not only will it push telecom and its related industries to the next level, but it will also open up new avenues of network applications that were limited by the speed before. From Industry 4.0 applications such as smart manufacturing to network slicing and AR-enhanced experiences, it will make a lot possible.

Right now, the world is looking at another transitionary period; shifting from 4G to 5G. According to projections, during this year, 5G subscriptions will cross the 1-billion mark; by 2026, half of the population of the Earth will have a 5G connection. By the time the decade ends, the new network will become ubiquitous.

Mark the Date: 5G in India in 2022-23

To the government's and the industry's credit, the work has been expedited and it looks like 5G might come sooner than expected. However, it does seem as though the government has placed a difficult deadline on the telcos and their partners. As the industry leaders have established, the rollout should be expected as soon as August this year, most likely on Independence Day, 2022.

The world is looking at another transitionary period; shifting from 4G to 5G. According to projections, during this year, 5G subscriptions will cross the 1-billion mark; by 2026, half of the population of the Earth will have a 5G connection.

"The variables have to be addressed and optimized before saying when 5G will come out. I think, if the variables are sorted out, we will be able to roll out 5G by August. If they don't, it will take more time. But we have emphasized to the government to address the issues, and they are being addressed quickly. If they get sorted, by mid-August, we will roll out 5G", Lt. Gen. (Retd.) Dr. SP Kochhar spoke at DQ DeepTech 2021.

Of course, all of this depends on the 5G spectrum auction, for which the government first needs to finalize the National Frequency Allocation Policy. Since the NFAP is a work in progress, the government has to pull off a miracle to hold the auction in April, May, or even June. The later it gets, the more difficult it becomes for telcos to roll out 5G in August.

The general public sentiment in India has been ambivalent. Many have questioned the need for a network upgrade when we had one half a decade ago. What's more, India's connectivity issues make it seem that a 5G rollout will only paper over the cracks. Its potential, though, makes it an important exercise for the government to facilitate rollout. The government wants to hold a spectrum auction in April-May 2022, as it will take the telcos at least a quarter to set up preliminary networks across the country. However, as the industry has repeatedly stated, a year-end deadline would have been more sensible.

Along with this, at the Union Budget 2022, Finance Minister Nirmala Sitharaman announced that the government will hold the 5G spectrum auction this year, with a rollout to be completed within 2022-23. So, we finally know when the new networks go live.

Who's Getting it First?

The government has been working on facilitating the rollout of 5G. Apart from enabling the ongoing 5G trials, the government also initiated a research project called the "Indigenous 5G Testbed Project". In the project, 8 agencies, including IIT Bombay, Delhi, Hyderabad, Madras, and Kanpur, along with IISc Bangalore, SAMEER, and CEWIT have been developing 5G since 2018.

As such, the cities that will get it first are Ahmadabad, Bangalore, Chandigarh, Chennai, Delhi, Gandhinagar, Gurugram, Hyderabad, Jamnagar, Kolkata, Lucknow, Mumbai, and Pune. So, if you live in any of those cities, the time is ripe to get a 5G phone (or not). The list was not compiled based on any randomness; Bharti Airtel, Vodafone Idea, and Reliance Jio have already set up trial networks in Gurugram, Pune, Gandhinagar, and Kolkata.

While these cities will see a 5G rollout as soon as August this year, the rest of the country should follow up soon. However, going by the usual proliferation rate, we can expect the new network to reach every nook and cranny only by the end of 2023. Even so, the government has only finalized the problematic mid-band spectrum for 5G; it is on track to hold a spectrum auction within the next few months.

What's Happening Right Now?

Since June last year, 13 telcos, gear makers, and technology partners have been running 5G trials across multiple locations in the country. All of the telcos have been looking at multiple network applications and developing use cases.

Each one of the telcos has a clearly defined direction of where the use cases are going. For instance, Bharti Airtel launched the #5GForBusiness initiative and focused its efforts on developing use cases meant for enterprise applications. The telco had said that it has partnered with the likes of Accenture, AWS, CISCO, Ericsson, Google Cloud, Nokia, and TCS. Given its capabilities, specifically the low latency and high network capacity, Airtel now has set its sights on enterprise customers. These customers can deliver high financial dividends, and to some extent, bragging rights. After all, India's telecom market has a history of one-upmanship, and Airtel wants to one-up everyone in the 5G department.

Vodafone Idea, on the other hand, focused its efforts on speed. Vi claimed to have hit a top speed of 9.85 Gbps on its 5G network, using the E-band boosters. However, the telco has also been working to develop enterprise solutions. Vi partnered with L&T to test 5G-based Smart City solutions. Under the partnership, the companies will create 5G use cases related to IoT and AI, using L&T's Smart City platform – Fusion. The companies will run the pilot project in Pune, where Vi is running its trials.

> 4G built the foundations for the app economy; 5G will propel that. In the next 5 years, with how ubiquitous social media and on-demand video content have become, network traffic will grow by as much as 50%. Give it a decade, and that same traffic would be 10 times higher.

Reliance Jio has been working across the board, even piloting the Voice & SMS services over 5G VoNR, becoming the first telco to do so. Jio SVP Sanjay Bhatnagar had said that the telco has also tested the interoperability of VoLTE and VoNR. Also, the telco has been bringing out multiple use cases and testing network applications at its test site in Gandhinagar, Gujarat.

The Spectrum Auction

TRAI has reported in its consultation paper that the DoT has asked for prices in the 526-698 MHz, 700 MHz, 800 MHz, 900 MHz, 1800 MHz, 2100 MHz, 2300 MHz, 2500 MHz, 3300-

3670 MHz and 24.25 – 28.5 GHz bands for 5G. Also, two new bands will debut at the spectrum auction; the 526-698 MHz and the mmWave bands. However, there has not been any official date on the same. The government wants to hold the auction as early as March, but no later than June.

Currently, the only point of contention is the price point. The telcos have demanded a huge reduction in spectrum prices, and the TRAI has recommended lower prices. However, the government has not relented yet. Per the consultation paper, TRAI uses a variety of methods to decide on the spectrum prices. First, it looks at international spectrum pricing, and then, it looks at the technical efficiency factor. Basically, a technical efficiency factor defines how a particular spectrum band is better than a benchmark spectrum band. For instance, the regulator decided on the base price of the 700 MHz spectrum by setting the 1800 MHz band as the benchmark. Then, it compared the two bands for technical superiority and priced the former band accordingly.

As such, TRAI has acknowledged the importance of mmWave in India. In clause 2.39, TRAI said, As per a report on "The Impacts of mmWave 5G in India" published by GSMA in October 2020, the mmWave spectrum, in particular, will play a crucial role in enabling the high-speed and ultra-low-latency features required by many 5G applications. India will benefit significantly from mmWave-enabled 5G. Over the period 2025–2040, it has been estimated that mmWave-enabled 5G will deliver $150 billion in additional GDP for India.

Therefore, TRAI has recommended DoT set a "balanced intermediate reserve price", so that the government can monetize the spectrum effectively. Furthermore, TRAI said that the price should not be too high so that the TSPs can participate in the auction; the telcos have repeatedly warned of low participation if the price does not come down.

5G For All

Right now, the world is sitting on the cusp of another revolution. With the number of devices increasing every year, IoT will take off, bringing with it a host of personal and enterprise applications. Along with this, customers inherently are changing. Only half a decade ago, no one could imagine the things that we can do these days; the COVID-19 pandemic would have been multiple times more disruptive in 2015.

But with the virtually unlimited things you can do with good internet, the connectivity demand will only rise. 4G built the foundations for the app economy; 5G will propel that. In the next 5 years, with how ubiquitous social media and on-demand video content have become, network traffic will grow by as much as 50%. Give it a decade, and that same traffic would be 10 times higher.

Telcos are sitting on an opportunity that will define the next decade, and their investment in 5G networks should reflect that. No one can deliver the kind of value 5G will require by building a 5G network over a 4G core. The time is now to move towards a 5G core and build a network proactively, with the end-user in mind. A network that can support the multilayered and complex digital lives people are leading these days. A few years ago, pre-4G, customers valued simplicity. This reflects upon the evolution that 4G sparked, and 5G would carry forward.

Whatever the end goal might be, this year will mark the beginning of something good in India.

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